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UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

IN RE SEAGATE TECHNOLOGY LLC
LITIGATION

Case No. 3:16-CV-00523

CORRECTED DECLARATION OF
STEFAN BOEDEKER IN SUPPORT OF
PLAINTIFFS’ MOTION FOR CLASS
CERTIFICATION

DATE: Feb. 9, 2018
TIME: 9:30 a.m.
DEPT: Hon. Joseph C. Spero
Courtroom G, 15th Floor

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I. INTRODUCTION

A. Qualifications

1. I am a Statistician and an Economist. I received a Bachelor of Science degree in Statistics and a Bachelors of Arts degree in Business Administration from the University of Dortmund/Germany in 1988. I received a Master of Science degree in Statistics from the University of Dortmund/Germany in 1988, and I received a Masters of Arts degree in Economics from the University of California, San Diego in 1992. I also completed Ph.D. requirements (except dissertation) in Economics at the University of California, San Diego.

2. I am currently employed as a Managing Director at the Berkeley Research Group ("BRG") in one of its Los Angeles area offices at 550 South Hope Street, Suite 2150, Los Angeles, CA, 90071. Prior to joining BRG, I was a Partner at Resolution Economics. I also held Managing Director positions at Alvarez & Marsal, Navigant Consulting, and LECG. I also held partner-level positions at Deloitte & Touche LLP, PricewaterhouseCoopers LLP, and Arthur Andersen LLP. At the three latter firms, I was responsible for the Economic and Statistical Consulting group on the West Coast. Before moving to the United States to attend graduate school, I worked as a statistician for the German Government for three years, from 1986 to 1989.

3. For over 25 years, my work has focused on the application of economic, statistical, and financial models to a variety of areas, such as providing solutions to business problems, supporting complex litigation in a consulting and expert witness role, and conducting economic impact studies in a large variety of industries including, but not limited to, healthcare, retail, technology, entertainment, manufacturing, automotive, energy and utilities, hospitality, and federal, state, and local government agencies.

4. I have extensive experience designing and conducting surveys and empirical studies as well as statistically analyzing results from surveys and empirical studies in both the litigation context as a consultant and/or designated expert and the non-litigation context as a statistical or economic consultant. I have issued numerous expert and rebuttal reports dealing with surveys and

1 statistical sampling related issues. I have been deposed on numerous occasions, and have also
2 testified in court regarding survey and statistical sampling-related issues.

3 5. I am not an engineer, or a database administrator or a computer hardware specialist. I
4 do not have an opinion one way or the other about the allegations in this case. Instead, I have relied
5 on my experience and expertise and have purely applied statistical methodologies based on the
6 assumptions provided herein as to the alleged false statements at issue in this litigation outlined in
7 the Consolidated Amended Complaint and per the instructions of plaintiffs' counsel.

8 6. All the facts and circumstances set forth in this report are known to me personally and
9 I am prepared to testify to them if called upon to do so. My curriculum vitae which includes matters
10 in which I have testified is attached to this report as Exhibit A. BRG is being compensated for its
11 work on this matter based on an agreed upon hourly billing rate schedule. My hourly billing rate for
12 professional services related to this case is \$650 and the billing rates of BRG staff supporting me on
13 this engagement range from \$150 to \$490. BRG's payment in this matter is not contingent upon my
14 opinions or the outcome of this litigation.

15 **B. Case Background**

16 7. It is my understanding that the defendant Seagate Technology, LLC ("Seagate") is
17 alleged to have failed to disclose facts about certain of their Drive products at issue in this litigation,
18 namely those bearing model number ST3000DM001 (collectively referred to as "Drives"). It is
19 Plaintiffs' position that Defendant failed to properly disclose to its customers the annualized failure
20 rate ("AFR") and the lack of suitability of the Drives in RAID arrays.

21 8. It is my understanding that Seagate's statements regarding its failure rates were
22 included in a campaign of other statements regarding the reliability of the Drives at issue in this case.
23 For example, it is alleged that Seagate marketed both the external and internal versions of the
24 Barracuda as highly reliable and dependable. The following statements, among others, appeared on
25 the order page for the Backup Plus on Defendant's website in 2012 (hereafter "2012 Backup Plus
26 webpage"):

27 a. "Your digital life safe and sound"

- b. "Backup Plus from Seagate is the simple, one-click way to protect and share your entire digital life—without getting in the way of the rest of your life."
- c. "Up to 4TB capacity for a lifetime of memories"
- d. "Backup Plus is the family of external drives from Seagate that lets you do more with photos and movies, protect everything in your digital life, and manage it all from a single, intuitive dashboard."
- e. "Space for everything you've got. No more having to pick and choose what you protect."
- f. "Protect...Photos, videos, and more. Automatically."
- g. "Life is full of amazing moments you want to remember forever. The Backup Plus desktop drive lets you set up easy automatic backups of all your stuff, so you know that even if 'life happens' to your computer, your memories are always protected."
- h. "Think of how many photos you've shared on Facebook or Flickr. With Backup Plus, you can easily download them right to your Backup Plus drive, so even more of your life is safe and sound."

9. Plaintiffs claimed that statements that are identical or virtually identical to the appeared on the Backup Plus webpage in 2013, and similar statements appeared there in 2014 and 2015.

10. Further, I understand from the Consolidated Amended Complaint that Seagate published reliability and data integrity specifications for the Drives. Specifically, Seagate claimed that the annualized failure rate ("AFR") of the Drives was less than 1% and that the maximum non-recoverable read errors per bits read was 1 per 10E14.

11. According to the Consolidated Amended Complaint, reports published by Backblaze¹ demonstrated that the Drives fail prematurely at extremely high rates. Additionally, Plaintiffs allege that the reports demonstrate that the Drives do not last nearly as long as comparable hard drives and that the Drives have an AFR that is much higher than that advertised by Defendant.

¹ Backblaze, Inc. ("Backblaze") is an online data backup company. Backblaze publishes reports on the reliability of the hard drives the company employs in the normal course of its business.

12. In particular, it is my understanding, that Defendant failed to accurately state the true AFR rate and suitability of the Drives. Instead of the truth, Defendant has claimed, and continues to claim and market, on its website and in its promotional and informational publications that the Drives:

- a. Have an annualized failure rate (“AFR”) of less than 1%, and
- b. Is “best fit” for Desktop Redundant Array of Independent Disk (“RAID”) Configurations.

13. I understand that plaintiffs seek to certifying the following nationwide class of consumers:

All individuals in the United States who purchased new, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive’s casing or chassis: STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101, STDU3000400, STEB3000100, STEB3000200, STEB3000400, STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

In the alternative, plaintiffs propose the following state classes under the omissions theory in these jurisdictions’ consumer protection laws:

All individuals in the jurisdictions of California, Florida, Massachusetts, New York, South Carolina, South Dakota, Tennessee, Texas, who purchased new, not for resale, on or before February 1, 2016, at least one Seagate model ST3000DM001 hard drive or at least one drive with any of the following model numbers on the box it was sold in or on the hard drive’s casing or chassis: STAC3000100, STAC3000102, STAC3000202, STAC3000402, STAC3000403, STAC3000404, STAC3000602, STAM3000100, STAM3000400, STAY3000100, STAY3000102, STBC3000101, STBC3000102, STBD3000100, STBM3000100, STBN6000100, STBP12000100, STBV3000100, STBV3000200, STCA3000101, STCA3000600, STCA3000601, STCA3000602, STCB3000100, STCB3000101, STCB3000201, STCB3000400, STCB3000401, STCB3000900, STCB3000901, STCP3000100, STCP3000400, STDT3000100, STDT3000400, STDT3000402, STDT3000600, STDU3000101,

1 STDU3000400, STEB3000100, STEB3000200, STEB3000400,
2 STEG3000100, STEG3000400, STFM3000100, or STFM3000400.

3 14. My opinions would apply equally to either class.

4 **C. Assignment**

5 15. I have been retained by counsel for Plaintiffs to develop an economic loss model to
6 quantify the damages, if any, suffered by the proposed class that are attributable to the purchase of a
7 product that was not as presented and advertised to the consumers. Specifically, I have been retained
8 to develop and perform an empirical study to assess the value that customers, who purchase Seagate
9 Drives, place on the specific statements outlined in Paragraph 12.

10 16. I have further been asked to use the results of the empirical study and other data to
11 develop an econometric/statistical model to quantify and estimate class-wide damages to purchasers
12 of Seagate products with the alleged misstatements due to not receiving benefits and features that
13 they paid for and that they were led to believe the Seagate Drives possessed.

14 17. One could argue that the entirety of the actual purchase price of a Seagate Drive could
15 be fully included in an economic loss model because the purchasers of a product with a false claim
16 did not receive what was advertised and what they intended to purchase. In my analysis, I consider
17 that consumers may still have obtained some value from the purchase of one or more of the Seagate
18 Drives at issue in this litigation even though they did not provide the features as stated in the alleged
19 misstatements detailed in Paragraph 12. This implies that the economic loss to the purchaser may
20 have been less than the entirety of the purchase price of the product. However, it cannot be ruled out
21 that the economic loss is equal to or even greater than the purchase price. This concept is explained
22 in detail in Section VII.C

23 **D. Materials Considered**

24 18. In forming my opinions for this report, I have considered the following materials:

- 25 a. Consolidated Amended Class Action Complaint, dated May 9, 2016.
26 b. Deposition testimony of Chadwick Hauff, dated June 8, 2017.
27 c. Deposition testimony of David Schechner, dated June 8, 2017.
28 d. Deposition testimony of Joshua Enders, dated June 8, 2017.

- e. Deposition testimony of Dennis Crawford, dated June 15, 2017.
- f. Deposition testimony of Dudley Dortch, dated July 12, 2017.
- g. Deposition testimony of James Hagey, dated July 24, 2017.
- h. Deposition testimony of Nikolas Manak, dated June 20, 2017.
- i. Deposition testimony of Christopher Nelson, dated June 2, 2017.
- j. Deposition testimony of Defendant 30(b)(6) Jeffrey Fochtman, dated August 18, 2017.
- k. In addition, I have considered all materials cited in the text and in the footnotes to this report and the materials produced by Amplitude Research described further below. All these materials (or relevant excerpts) are being produced with this report.

E. Structure of the Report

- 19. The remainder of this report is structured as follows:
 - a. Section II states a summary of my opinions.
 - b. Section III gives a brief overview of the Hard Disk Drive market.
 - c. Section IV gives an overview of the methodology starting with the derivation of an economic loss model based on supply, demand, price setting mechanisms, and the relationship between prices and a consumer's willingness-to-pay for a product or features of a product.
 - d. Section VI contains a detailed description of the empirical study that I performed. In Section 6, I also introduce Choice Based Conjoint Analysis as a tool to quantify the impact of changing market conditions on consumers' choices and willingness-to-pay.
 - e. Section VII presents the results from applying advanced statistical estimation techniques to obtain economic losses suffered by the members of the proposed class based on the results from a conjoint study.
 - f. Section VIII concludes that it is possible to reliably quantify class-wide economic losses given the proposed methodology and the results from a properly designed and implemented conjoint study. In addition, in this section I provide a damage methodology that proves that for AFRs sufficiently large the consumers are entitled to a full refund of the purchase price. I further outline how class-wide damages can be reliably calculated utilizing the results from the proposed methodology.

II. SUMMARY OF OPINIONS

20. I have been asked to give an opinion on the economic loss suffered by the class given Seagate's alleged nondisclosures regarding Annual Failure Rates ("AFR") of its Drives. If called to testify at trial, I would opine based on data derived from an empirical consumer study that was conducted under my design and supervision and the statistical analysis of the data obtained from the empirical study that there are two possible theories of economic injury suffered by the class.

21. First, if the jury were to decide that the true failure rates of the Seagate Drives was in excess of 10%, the economic loss quickly approaches the sales price of the product and even exceeds the sales price for extremely high failure rates indicating that a Drive with an unreasonably high AFR would be perceived as an economic bad. In those instances, the entire purchase price of the Seagate Drives would be the appropriate measure of economic loss to the class members.

22. Second, if the jury were to decide that the true AFRs of the Seagate Drives were for example 3%, 5%, 8%, or 10% the economic loss of each class member would be 16.9%, 33.7%, 59.1%, and 75.4% of the sales price of the Seagate Drive. Applying these percentages to the median sales price of \$89 in our study the economic loss per class member would be \$15.04 if the failure rate were 3%, \$29.99 if the failure rate were 5%, \$52.60 if the failure rate were 8%, and \$67.11 if the failure rate were 10%.

23. It has to be pointed out that the model can be further refined to enable the quantification of economic losses for different interim AFRs as well as for different sales prices of the Seagate Drives.

III. THE HARD DISK DRIVE MARKET

24. A hard disk drive ("HDD" or "Drive") is a data storage device used for storing and retrieving digital information using rotating disks – which are called platters - coated with magnetic material with motors to spin or "drive" the discs. Data is read in a random- access manner, meaning individual blocks of data can be stored or retrieved in any order rather than sequentially by the use of a moving actuator arm – known as a head arm – to read and write data by magnetically changing or reading areas on the platters pursuant to instructions sent from the computer. In addition to

1 mechanical components, Drives also have firmware embedded in their memory. Storage capacity of
2 HDDs is typically measured in terms of gigabytes (“GB”) and terabytes (“TB”). One GB is 1,000
3 megabytes, and one TB is 1,000 GB, or one million megabytes.

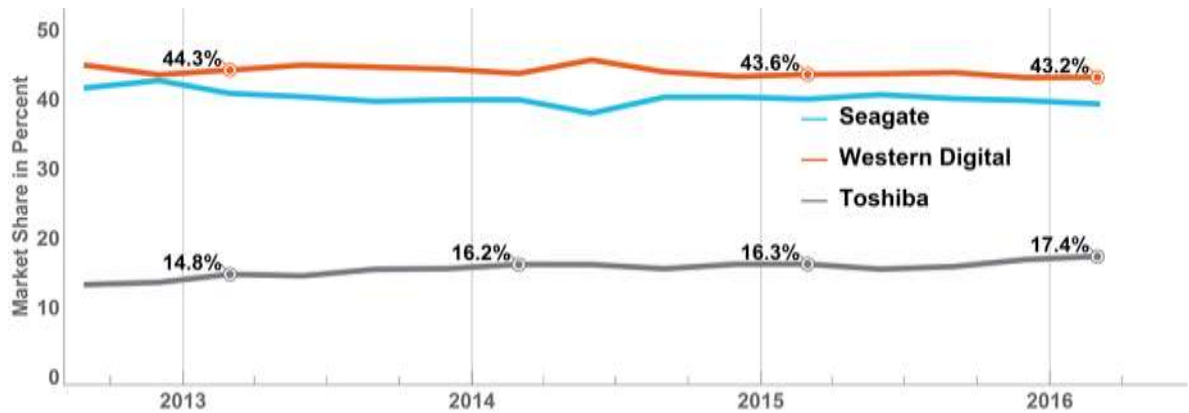
4 25. There are two main types of Drives: internal and external. An internal Drive is
5 installed inside the casing of a computer or a Network Attached Storage (NAS) device. An external
6 Drive is enclosed in its own casing, has an external power supply, and is connected to a computer
7 with Universal Serial Bus (“USB”) cables or similar types of connectors.

8 26. Some Drives can also be used in NAS and RAID devices. NAS is a computer
9 appliance that acts as a data storage server. NAS systems are available for commercial and home use,
10 and many individuals use them to share and stream multimedia files to multiple home computers,
11 gaming consoles, tablets, phones, and Smart TVs. A NAS consists of three main components: 1) an
12 enclosure; 2) hardware such as a motherboard, a CPU, and memory; and 3) at least one Drive. RAID
13 is a data storage technology that combines multiple Drives in a single unit for the purposes of data
14 redundancy, performance improvement, or both. Data redundancy refers to the writing of the same
15 data to multiple Drives, such that if one drive fails the data is still available on the other drive(s).

16 27. The top manufactures in the market are Western Digital, Seagate, and Toshiba.
17 Market shares have remained relatively stable from 2012 to 2016. Western Digital supplied about
18 43.2% of the HDD market in Q1 2016, while Seagate was the second largest supplier with 39.4%
19 market share and Toshiba and other suppliers had a 17.4% market share.²

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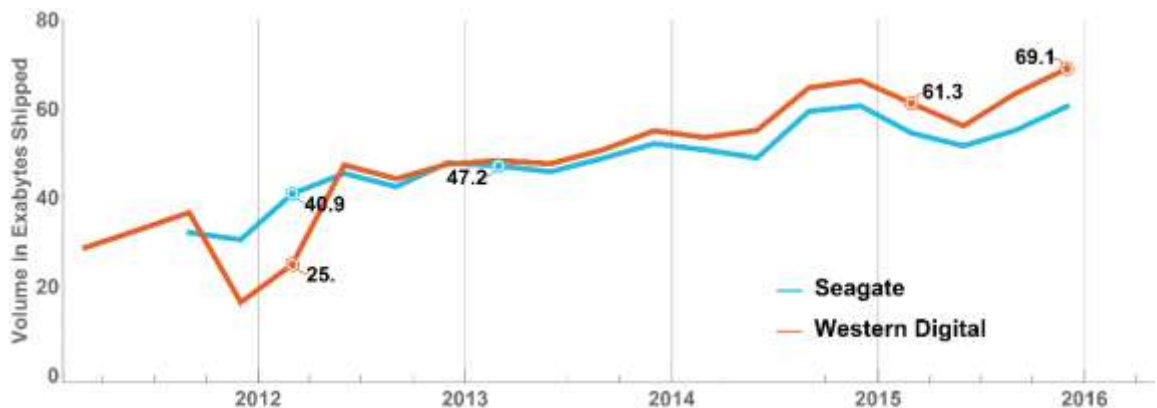
² <http://www.anandtech.com/show/10315/market-views-hdd-shipments-down-q1-2016/2>.



Source: Anandtech.com based on data provided by Seagate and Western Digital.

Figure 1: Market Shares of Hard Drive Makers

28. As can be seen in Figure 2, the total HDD capacity shipped (capacity per drive * volume) by the two largest manufacturers has increased more than 2 times between 2011 and 2015.³



Source: Anandtech.com based on data provided by Seagate and Western Digital.

Figure 2: Exabytes Shipped by Seagate and Western Digital

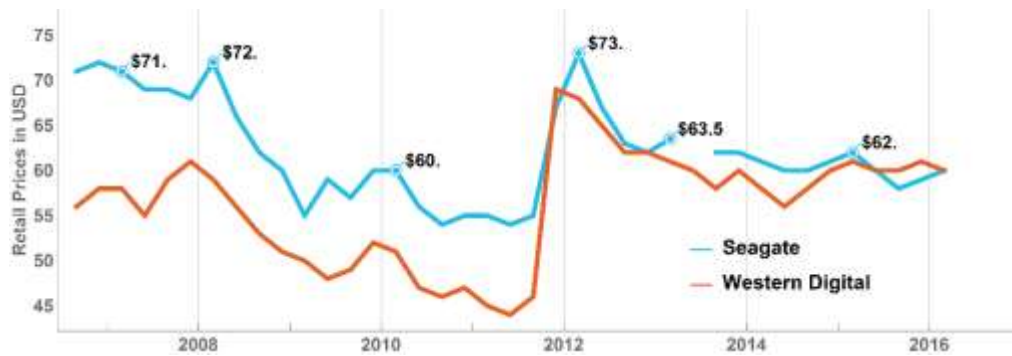
29. HDD average selling prices per unit have hardly changed despite substantial improvements in capacity. As of September 2017, traditional storage drives cost around 7 to 8 cents per usable gigabyte.⁴ As of first quarter 2016, the retail price for a drive manufactured by Seagate or Western Digital was about \$60 (Figure 3).⁵ The spike in retail prices from 2nd quarter 2011 to 1st quarter 2012 is likely due to a shortage of critical components caused by flooding in Thailand that affected several drive manufacturers.⁶

³ <http://www.anandtech.com/show/10098/market-views-2015-hard-drive-shipments>.

⁴ <https://www.giiresearch.com/report/if119476-hard-disk-drive.html>.

⁵ <http://www.anandtech.com/show/10315/market-views-hdd-shipments-down-q1-2016/3>.

⁶ <http://www.zdnet.com/article/thailand-floods-to-lead-to-hard-drive-shortages-for-months/>



Source: Anandtech.com based on data provided by Seagate and Western Digital.

Figure 3: Average Selling Price of Hard Drives in USD

IV. THEORETICAL FRAMEWORK OF ECONOMIC LOSS

30. In this section, I use a generic example to describe in basic economic terms how prices are set for products and how it can be tested if damages exist, and if they do exist, how to quantify them and how to determine the appropriate class-wide compensation.

A. Demand and Supply in a Competitive Market

1. Willingness-to-Pay

31. In economic theory, willingness-to-pay is derived from “Utility”. Utility describes a consumer’s preferences and it is a measure of the value or usefulness of a good or service to that consumer.⁷ Therefore, utility does not have a unit of measurement and many economic books have used the concept of “utils” as a unit of measurement. The empirical study developed in this report associates a monetary value to a consumer’s utility.

32. To explain the concept, let us assume that it is known how much benefit or utility each consumer in a given market derives from a product or service and that a method has been established to express the utility in monetary terms. The willingness-to-pay is highest price a customer is willing to pay for the product, which is based on the perceived utility derived from the product. The consumer will purchase the product if the market price of the product is lower than or equal to his willingness-to-pay but he will not purchase the product if the price is higher than the willingness-to-pay.

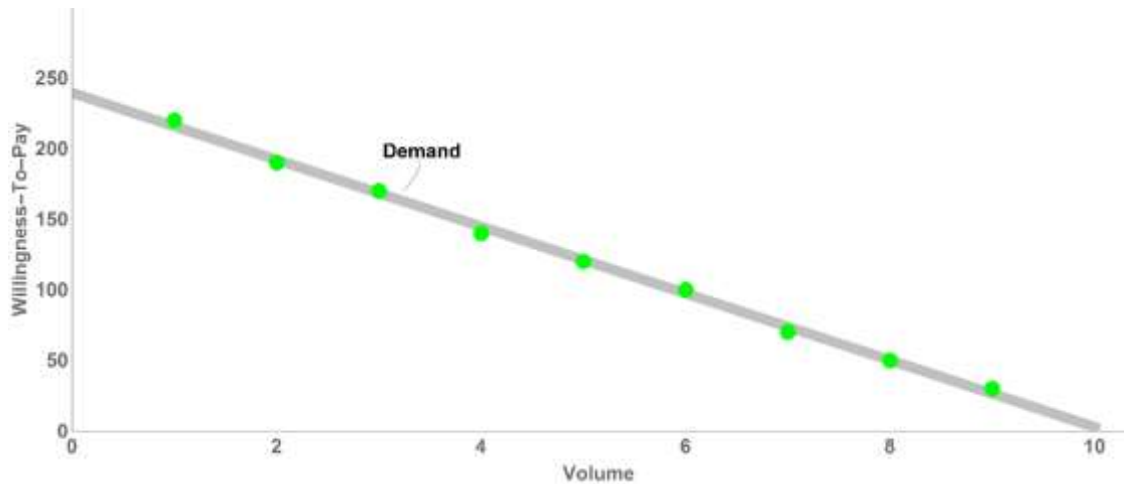
⁷ Hal R. Varian, Intermediate Microeconomics, 8th Edition, 2009, Page 54.

1 33. In that sense, the individual willingness-to-pay for a product differentiates the buyer
2 from the non-buyer for a certain product. There is no other correlation between the individual
3 willingness-to-pay and the market price. In this context, the marginal consumer is defined as the
4 consumer whose willingness-to-pay equals the market price.

5 34. With this knowledge, it is now possible to rank the consumers by their willingness-to-
6 pay. As an illustrative example, let us assume that the consumer with the highest willingness-to-pay
7 is willing to spend \$220 for a 3 terabyte (“TB”) Drive. If the price of the product were \$200, this
8 consumer would purchase the product but nobody else would. This consumer would also buy the
9 product for any price less than \$200. If there is an additional consumer with the next highest
10 willingness-to-pay of \$190, then this consumer and the consumer with a willingness-to-pay of \$200
11 would purchase the product, and so forth. Each consumer would buy the product at a price that is
12 equal to or less than their respective willingness-to-pay. If a consumer’s willingness-to-pay is less
13 than the price for the product, then this consumer will not buy the product.

14 35. Based on the ranking of consumers by their willingness-to-pay, a demand curve can
15 be constructed in the following way: In a diagram that depicts the amount of the willingness-to-pay
16 for each individual consumer on the vertical axis and the number of consumers on the horizontal
17 axis, the demand curve will begin in the top left corner at the intersection of one consumer and a
18 willingness-to-pay of \$220. The next data point is at the intersection of two consumers and a
19 willingness-to-pay of \$190, and so forth.

20 36. The demand curve would look like a downward facing set of stairs. For simplicity,
21 textbooks typically stylize the demand curve as a smooth downward sloping line or curve. Figure 4
22 below illustrates this concept.



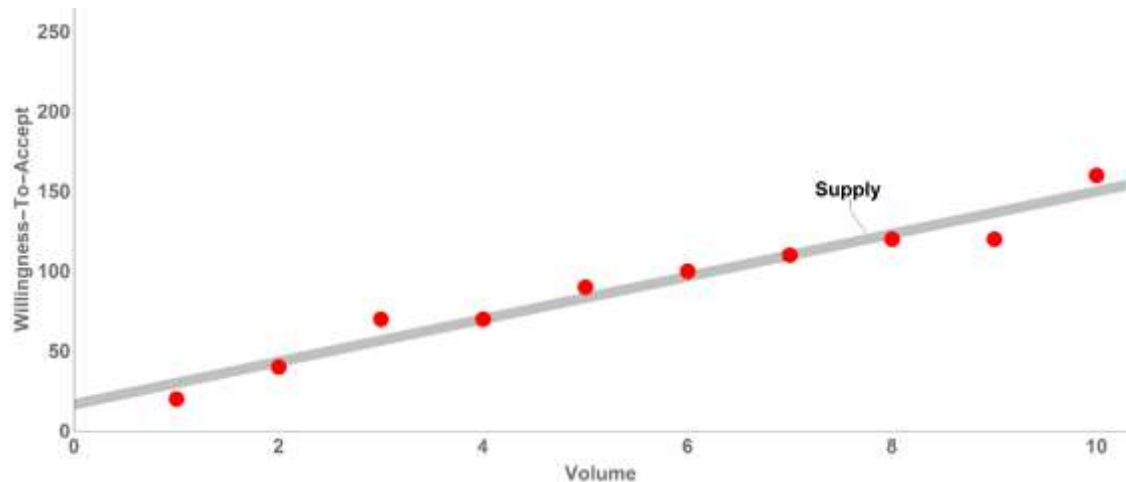
Source: Own analysis based on hypothetical data

Figure 4: Willingness-to-Pay and Demand

2. Willingness-to-Accept

37. Following the same principle as in the example of developing the demand curve, we can also determine the minimum price at which each manufacturer is willing to sell the product. This is called the willingness-to-accept, which is equal to the marginal cost of the manufacturer. The marginal cost is the cost the manufacturer incurred when producing the last or marginal unit of the product.

38. Like the consumers on the demand side, the manufacturers can be ranked by their willingness-to-accept. In a diagram with volume on the horizontal axis and prices and willingness-to-pay on the vertical axis, the manufacturer with the smallest marginal costs, say \$20, will be positioned on the left. If the price of the product were to be just above \$20, only this manufacturer would be willing to accept the price. Assuming that the next manufacturer offers one unit for \$40, at the price of \$40 two units would be offered in the market and so on. When connecting all ranked willingness-to-accept, we get the supply curve. It typically slopes upwards from left to right. The supply curve would look like an upward facing set of stairs. For simplicity, textbooks stylize the supply curve as an upward sloping smooth line or curve. Figure 5 below illustrates the concept.

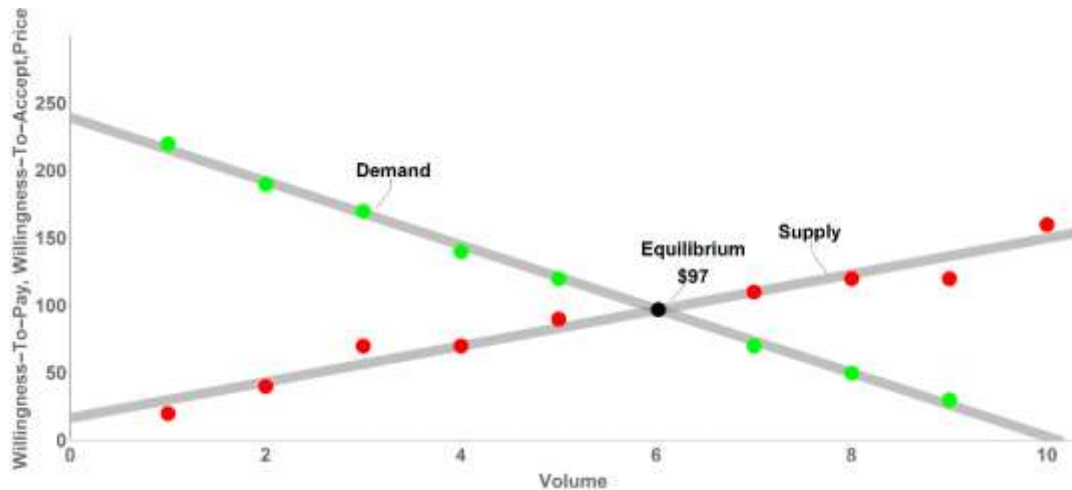


Source: Own analysis based on hypothetical data

Figure 5: Willingness-to-Accept and Supply

3. Market Equilibrium

39. The market balances supply and demand. At a price of \$30, almost all consumers in my example would purchase the product but the manufacturers would offer only one unit. Conversely, at a price of \$220, only one consumer would be willing to purchase the product while all manufacturers would be willing to sell the product. In the generic example, the market clears at a price of \$97. At this point, not all but most consumers and manufacturers will be brought together. In the graphical representation the supply and demand curves intersect (Figure 6). If the price exceeds \$97, more manufacturers would offer their product but fewer consumers would be willing to purchase the product. If the price drops below \$97, more consumers would be willing to purchase the product but fewer manufacturers would be willing to sell the product. For the marginal consumer, the price of \$97 is equal to the willingness-to-pay; and for the marginal manufacturer, the equilibrium price of \$97 is equal to the willingness-to-accept.



Source: Own analysis based on hypothetical data

Figure 6: Supply & Demand

40. The equilibrium price is not the simple average of all consumers' willingness to pay. Rather, the equilibrium price depends on supply and demand. The equilibrium price is the price where the supply curve and the demand curve intersect. Every consumer to the left of the marginal consumer has a willingness-to-pay that exceeds the equilibrium price, and therefore, will purchase the product.

41. The difference between the willingness-to-pay and the market price can also be illustrated with a real-world example: In an eBay auction, I may have put my eye on an item. I put my upper limit for my bids at \$200. This upper limit signals my willingness-to-pay. Given that willingness-to-pay, if I saw the same item with a "Buy it now" price tag of \$100, I would buy it for \$100. What happened in this example? Did my utility from purchasing the item suddenly change? Did my willingness-to-pay change? Obviously not. However, what has changed is that the projected amount that I would pay going through the bidding process is different than the price I will pay when the competing offer is presented to me. In other words, the willingness-to-pay does not necessarily reflect the actual price that a consumer ends up paying for a product.

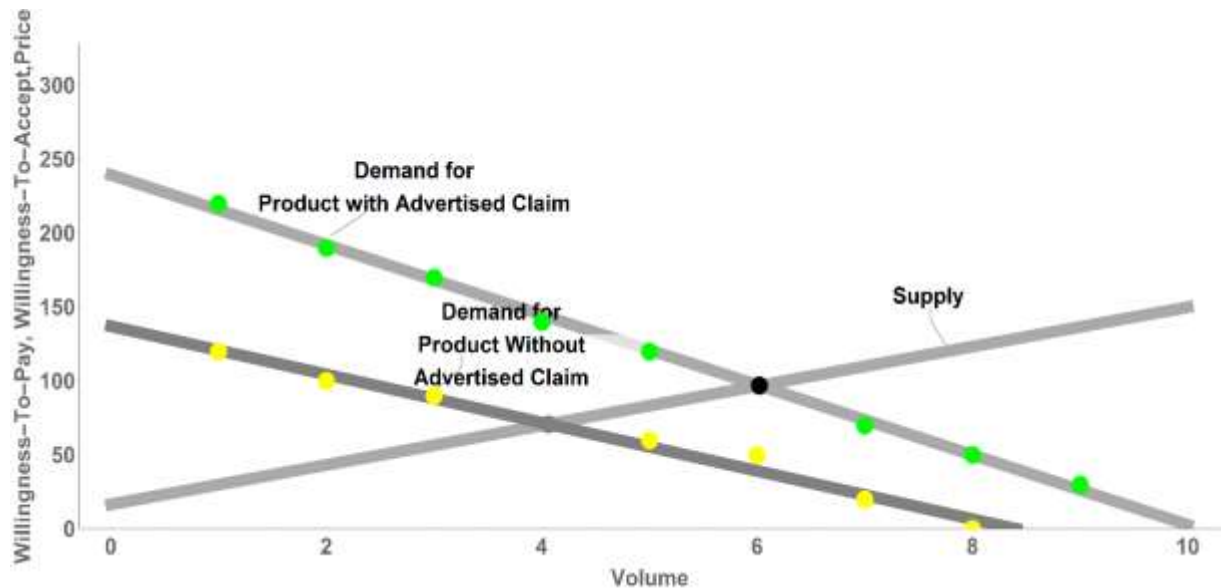
B. Shifting Demand Curves and Changes in Equilibrium Price

42. Based on Lancaster's theory of utility⁸ – the utility a consumer derives from a product, and, therefore, the consumer's willingness-to-pay for the product is aggregated from the willingness-to-pay for each of the product's characteristics, parts, and features. In this case, the products are Seagate Drives, and the characteristics of the product are capacity, connectivity, portability, reliability, warranties, and other features.

43. A consumer's overall willingness-to-pay for Seagate Drives is equal to the weighted sum of the willingness-to-pay the consumer expresses for each individual attribute. Changes in the composition of the attributes may lead to a shift of the demand curve for the hard drive. The change in the composition of the product's attributes can relate to changes in tangible attributes such as capacity, connectivity, portability, reliability, warranties, etc. It can also relate to statements about the product and advertised features of the product that are used to market the product to the consumers. In the case where statements used for marketing purposes are alleged to be false and misleading, it has to be determined if and by how much the demand curve shifts when the consumers learn about the false and misleading statements at the point of purchase. If the demand curve shifts downward some consumers may still be willing to buy the product but at a lower price and some consumers may no longer be willing to buy the product. Figure 7 below illustrates the scenario:

- a. Where one or more of the claims about the product are false or misleading, and
- b. Where the consumers receive information about this false or misleading claim at the point of purchase.

⁸ Lancaster, Kelvin J. (1966), "A New Approach to Consumer Theory," Journal of Political Economy 74 (2): Pages 132–157.



Source: Own analysis based on hypothetical data

Figure 7: Shift in the Demand Curve and the Effect of the Equilibrium Price

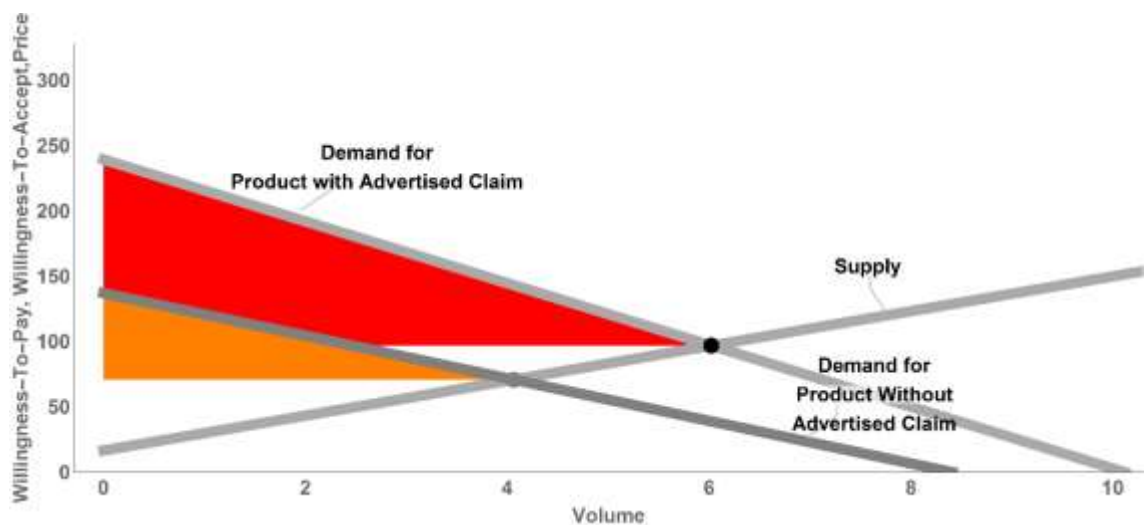
44. In the following paragraphs, I will refer to the situation where the consumer bought the Drives without having the knowledge that certain information is false and misleading as the “actual-world” and the situation where the consumer was informed at the point of purchase of the false and misleading information about the Drives as the “but-for-world”.

45. If consumers are willing to pay less for the product knowing that the advertised claim was false in the but-for-world, then it can be empirically tested how this new information impacts the demand for the product. If the demand curve shifts downward, then a drop in overall willingness-to-pay can be observed,⁹ although the drop in willingness-to-pay may vary across consumers. The consumers are ranked again according to their willingness-to-pay, resulting in the yellow dots in Figure 7, which defines the new demand curve.

46. The new demand curve may have a different shape than the demand curve for the product where the consumer does not know that the claim is false. All else equal, the shift of the demand curve results in a new market equilibrium, where the price and the transaction volume are lower. This is the new market equilibrium in the but-for-world.

⁹ In Sections 4 and 5 in this report, I describe an empirical study I designed to test if a shift in the demand curve had occurred if the consumers had known about the false and misleading statements alleged in the Complaint.

47. In economic theory, the net benefit to each consumer purchasing a given product is the difference between the willingness-to-pay and the price paid. Aggregated across all consumers in a market, the net benefit to all consumers is defined as consumer welfare. It is equal to the area under the demand curve and above the price line (red area and dark orange area in Figure 8). If the claim about the product is known to be false at the point of purchase, the demand curve will shift downwards (dark grey line in Figure 8). The new consumer welfare after the shift in the demand curve due to the false claim is equal to the area under the new demand curve and above the new price line (light orange area in Figure 8).



Source: Own analysis based on hypothetical data

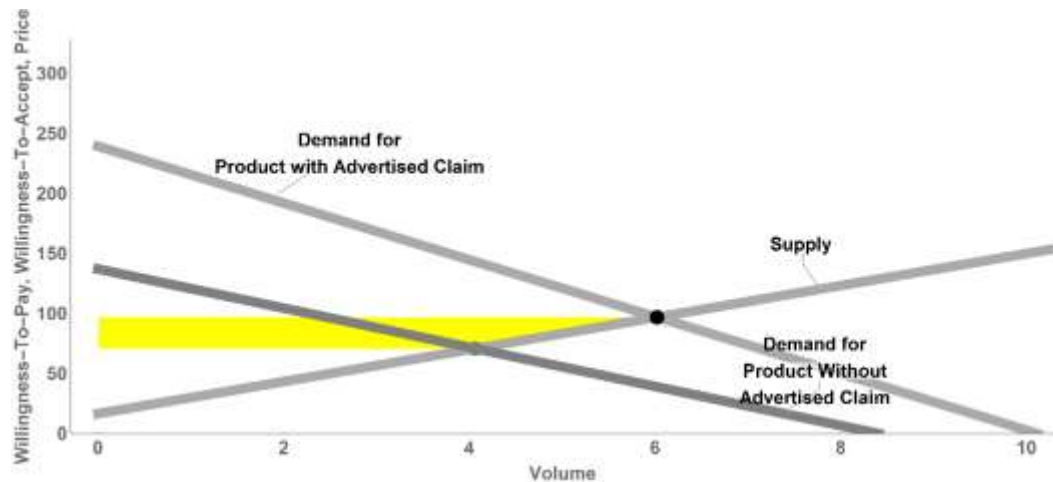
Figure 8: Consumer Welfare for Product with and Without a False/Misleading Claim

48. Since the demand curve for the product with the known-to-be-false claim is below the demand curve for the product absent a false claim, the consumer welfare for the product with the known-to-be-false claim is generally smaller than the consumer welfare of the product absent a false claim. Therefore, the consumers will have suffered economic losses.

49. Another way of looking at the economic loss to the consumer focuses on the manufacturer. Generally, a manufacturer's welfare is the difference between the willingness-to-accept and the price obtained in the market. Aggregated over all manufacturers, the manufacturers' welfare is the area below the price line and above the supply curve.

50. Corresponding to the consumers' welfare, we can also derive the manufacturer's welfare or gross profit. For each unit, the manufacturer's welfare is the difference between the price

received and the marginal costs of producing the unit. A shift in the demand curve results in a change in the manufacturer's welfare. In Figure 9 below, the difference in manufacturers' welfare between the product with the false claim and the product without the false claim is depicted by the yellow area. Recall that in the equilibrium between supply and the demand for the product with the claim was that six consumers would have paid \$97 (see Figure 6). In the market equilibrium depicted in Figure 9, for the product with the false claim, four consumers would have paid \$70.9 instead of \$97 when the claim was known to be false at the point of purchase. In addition, two consumers who purchased the product would not have purchased the product with the false claim in the new market equilibrium. The yellow area in Figure 9 depicts the additional manufacturers' welfare obtained by not disclosing that the claim was false. Therefore, the manufacturer gains at the cost of the consumer.



Source: Own analysis based on hypothetical data

Figure 9: Difference in the Manufacturers' Welfare between Producing the Product with and Without the False/Misleading Claim

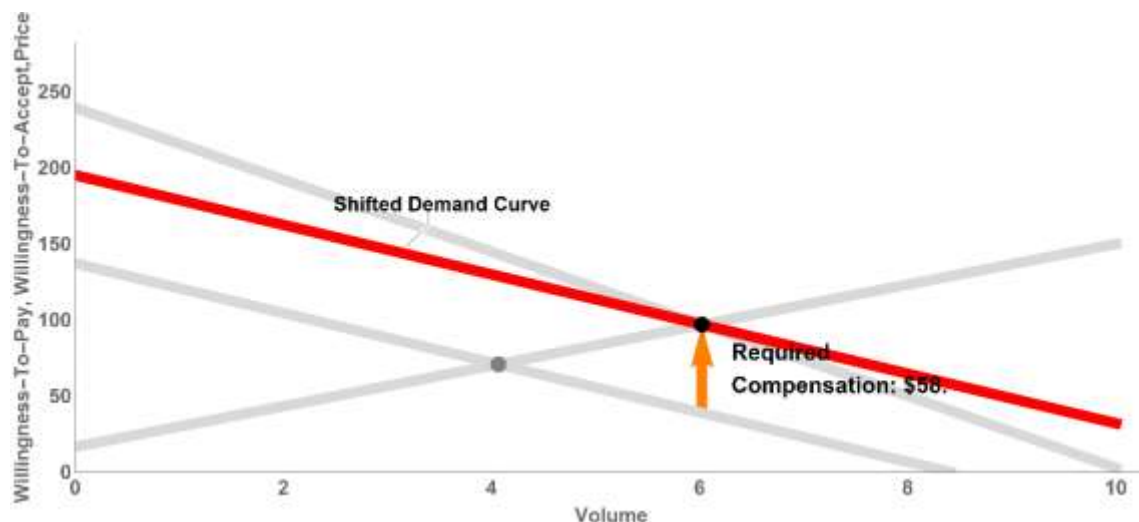
C. A Model of Economic Loss

51. Figure 9 shows how the false or misleading advertising increases the manufacturer's gross profits at the expense of consumers. The excess profit due to the false or misleading advertising would be considered restitution to the plaintiff in a legal framework that is built on profit disgorgement, as for example intellectual property. However, in this case, profit disgorgement would not compensate consumers for their economic loss. Instead, the proper economic loss methodology in this case has to be based on the loss in utility and the associated shift in demand of the affected consumers.

52. To make consumers whole for the economic losses, every consumer would have to receive an additional payment. The payment has to be sufficiently large to vertically shift the demand curve such that the demand curve for the product with the known-to-be-false claim plus the additional compensation intersected with the supply curve in the equilibrium for the product if the claim were true.

53. To determine how much the demand curve would have to be shifted, we need to focus on the marginal consumer in the market for the product without the false claim and compare the price she had paid to the price she would have paid for the product with the known-to-be-false claim at the point of purchase.

54. The compensation to make the marginal consumer whole after purchasing the product with the false claim is not simply the difference between the equilibrium prices on the demand curve for the product without the false claim and the demand curve for the product with the known-to-be-false claim (Figure 10). Rather, the compensation of the marginal consumer needs to be equal to the difference between the price this marginal consumer would have paid for the product with the known-to-be-false claim and the product without the false claim.



Source: Own analysis based on hypothetical data

**Figure 10: Compensation Required to Make Consumers Whole
After Purchasing Product with False/Misleading Claim**

1 55. In the example illustrated in Figure 10 above, the marginal consumer paid \$97 for the
2 product before becoming aware of the false claim, but would have paid only \$38 for the product with
3 the false claim. The difference in willingness-to-pay is \$58 (\$97 minus \$38).

4 56. The correct way to measure the economic loss to the class members considers that the
5 downward shift in the demand curve is comprised of two components: a) a drop in units sold as
6 measured on the horizontal axis, and b) a drop in the price paid by customers who are still buying the
7 product even after receiving the information that the product does not have the features as advertised.

8 57. In the illustrative example in Figure 10 above, the new market equilibrium occurs at a
9 lower price (\$55 instead of \$97) and at a lower number of units sold (4 instead of 6). Each buyer of
10 the defective product has to be made whole because they overpaid for the product. The price that
11 makes everyone whole is the price at which all 6 original buyers of the product would buy the
12 product again. In the illustrative example in Figure 10 above this price can be found by moving down
13 the shifted demand curve to find the price at which the original number of buyers would purchase the
14 product again. In the illustrative example above, this price is \$38.

15 58. All else equal and depending on the shape of the supply curve and the demand curve
16 before and after the disclosure of the information about the AFR at the point of purchase, the
17 economic loss will differ, and depending on the severity of the defect disclosed may even be equal to
18 or larger than the purchase price. In Sections 7.2 and 7.3, I discuss the instances where the disclosed
19 defect may be so severe that the consumption of the product will lead to negative utility and the
20 product turns into an economic bad.

21 **D. Consideration of the Supply Side in the Economic Damages Model**

22 59. The supply curve in the damages model is identical for the actual world (no
23 disclosure) and the but-for-world (the same Seagate Drive is now offered with full disclosure of the
24 false and misleading claims by the sales person at the point of purchase). The units of the product
25 that were sold with the false claim are identical. Therefore, the shift in the attribute level has no
26 impact on the marginal costs of the supplier and therefore the supply curve. Consequently, only the
27 changes in the demand curve are relevant for the damage assessment.

1 60. Because the Seagate Drive supplied in the actual world and the but-for world are
2 identical and the marginal costs in the actual and the but-for-world do not change, the only relevant
3 question is if the additional information of the disclosure (*i.e.*, AFR rate higher than advertised and
4 RAID suitability properly disclosed) at the point of purchase makes the Seagate Drive actually sold
5 inferior to the Seagate Drive as advertised in the eyes of the consumer. If the consumer perception
6 changes such that the Seagate Drive that is not as advertised is viewed as inferior the demand curve
7 will shift downwards. This implies that for an upward sloped supply curve for the product the
8 downward shift of the demand curve is associated with a drop in the equilibrium price.

9 **E. Approaches to Estimating the Value of Individual Attributes in Composite Products**

10 61. In general, there are two different types of approaches to estimate the values of the
11 individual characteristics, parts, and features that together form a composite product when there is no
12 direct market for the individual characteristics, parts, and features (also known as attributes; price is
13 also considered an attribute of a product) themselves:

- 14 a. Revealed Preference based, and
- 15 b. Stated Preference based.

16 62. Revealed Preference based approaches observe actual purchases by consumers or
17 published prices and infer from that information the decomposition of the overall price of the
18 composite product into its constituent attributes. This is most often being accomplished by using
19 hedonic pricing models where the actual transaction prices of the composite product with varying
20 attributes is regressed on the specifications of the composite product. The regression coefficients are
21 then interpreted as the implicit market prices of each attribute. Whereas hedonic pricing models
22 would have been an option, we do not have access to reliable data on annualized failure rates
23 required in this case.

24 63. Stated Preference based approaches involve asking individuals directly or indirectly
25 how much they value a particular product. This is done by investigating how much they would be
26 willing to pay for a particular attribute/feature in a composite product. In this context, Conjoint
27 Analysis is an approach exploring respondents' preferences over multiple sets of choices, which
28

1 produces rich data sets and numerous data points from which to estimate the value of the
 2 attribute/feature of interest. Conjoint Analysis is conducted in a survey setting where demographic,
 3 socio-economic, and general decision-making processes and preference information about the
 4 product in question collected and integrated into the estimation process. The particular strength of
 5 Conjoint Analysis is the fact that the stated preferences are derived from indirect questions, thereby
 6 avoiding the pitfalls of strategic responses in direct questioning.

7 64. In summary, due to the data limitations required for a hedonic pricing approach, I
 8 conclude that Conjoint Analysis is the most appropriate approach in this case to estimate the values
 9 of the individual attributes and features in question to assess the extent to which the omissions about
 10 the true features of the Seagate Drives resulted in a loss of utility to the consumers, and thus created
 11 economic losses to the members of the proposed class.

12 **V. METHODOLOGY OF THE EMPIRICAL STUDY**

13 **A. Conjoint Analysis –Methodology**

14 65. Conjoint analysis enjoys wide use in market research and is discussed in depth in the
 15 market research literature.¹⁰ Over 14,000 commercial applications of Conjoint Analysis are
 16 estimated to take place each year.¹¹ Vithala Rao's book, *Applied Conjoint Analysis*, gives numerous
 17 examples of the widespread use of Conjoint Analysis including, but not limited to, several high-
 18 profile applications by large corporations and large public agencies such as (i) Microsoft for pricing
 19 newly released software products, (ii) Proctor & Gamble for consumer-goods pricing and new
 20 product development, (iii) Marriott Corporation for the development of the Courtyard hotel brand,
 21 and (iv) T-Mobile for developing optimal cellular plans. Conjoint Analysis was also integral to the
 22 development of the EZPass electronic toll collection system by regional transit agencies in New
 23 York and New Jersey in the 1990s.¹²

24
 25 ¹⁰ See, for example: Rao, Vithala, *Applied Conjoint Analysis*, Springer-Verlag, 2014.

26 ¹¹ Orme, Bryan K, *Getting Started with Conjoint Analysis: Strategies for Pricing Research*,
 27 2nd ed., Madison: Research Publishers, 2005.

28 ¹² Rao, Vithala, *Applied Conjoint Analysis*, Springer-Verlag, 2014, Chapters 6.4 and 6.5.

1 66. The general idea behind Conjoint Analysis is that consumers' preferences for a
2 particular product are driven by features or descriptions of features embodied in that product.
3 Conjoint Analysis is a set of econometric and statistical techniques that have been developed to study
4 consumers' decision-making processes, determining trade-offs between products, features, and price,
5 as well as quantifying consumers' gains and/or losses of utility when choosing between different
6 alternatives. By simulating real world and/or hypothetical choices between product features and
7 prices under different levels of information, Conjoint Analysis is ideally suited to model the impact
8 of different choice scenarios on a consumer's utility function.

9 67. The data required for a Conjoint Analysis are collected in the setting of a survey
10 where survey participants are shown product profiles with different levels of each attribute. The
11 survey participants are consumers who currently are or recently have been in the market for the
12 product of interest – in this case Seagate Drives. After reviewing a set of choice menus of product
13 attributes and their levels, survey participants are then asked to indicate their preferences for those
14 profiles. The product profiles include choice options for different price points for each set of features
15 on the choice menu.

16 68. After the completion of the survey, the Conjoint Analysis uses data from the survey
17 on the attribute levels of the product profiles shown, and the resulting preferences or choices of
18 respondents, to decompose the respondents' preferences for a product into the partial contribution of
19 these attribute levels ("part-worths") to overall product utility using appropriate statistical methods.
20 The statistical models used in my analysis – Mixed Logit Models and Hierarchical Bayesian
21 Estimation – will be discussed in more detail in Section 6 "Economic Loss Model." These statistical
22 estimation techniques quantify the part-worths for feature levels such that the resulting estimated
23 part-worths best predict respondents' preferences or choices from the survey.

24 69. The price reduction needed to compensate for the loss of a feature, or the additional
25 price customers would pay for the inclusion of a feature can then be calculated and a variety of
26 choice situations and trade-offs between choices can be modeled and their outcomes can be precisely
27 quantified. The precision, and thus the reliability, of the resulting estimations depends on the number
28

1 of survey participants. The more respondents take part in the survey, the more precise the resulting
2 predictions are.

3 70. For this assignment, I applied a form of Conjoint Analysis known as Choice-Based
4 Conjoint Analysis (“CBC”). In CBC, study participants are shown sets of product profiles (called
5 “choice sets” or “choice menus”), and are asked to choose the profile that they would prefer to
6 purchase if the choice menu offered would describe the only products that were available to them.
7 CBC survey methods closely mimic real-world purchase processes.¹³ Conjoint Analysis allows for
8 the prediction of the probability that a respondent will choose any product profile that is described by
9 the part-worths and can do so for any competitive set of products.¹⁴ Based on the estimations, it is
10 also possible to simulate how choice shares would change in a market based on a change in overall
11 price. CBC enables us to determine the difference in value (measured in dollars) that customers place
12 on a Seagate Drive that claims reliability compared to an otherwise identical Seagate Drive that is
13 not as reliable as claimed.

14 **B. Statistical Estimation Techniques Applied in Conjoint Analysis**

15 71. The underlying econometric and statistical estimation techniques of the Conjoint
16 Analysis are based on Mixed Logit models and Hierarchical Bayesian Estimation techniques, which
17 are widely employed in economics and marketing research to analyze preferences over a discrete set
18 of choices.¹⁵

19 72. Mixed Logit models use the idea that each consumer assigns a utility to each choice,
20 and this utility measures the attractiveness of each choice. These utility values are correlated with the
21 attributes of the actual choice (for example, adding an extended warranty to an otherwise identical
22 Seagate Drive or including the claim of reliability on an otherwise identical Seagate Drive where it is

23 ¹³ Orme, Bryan K, *Getting Started with Conjoint Analysis: Strategies for Pricing Research*, 2nd
24 ed., Madison: Research Publishers, 2005.

25 ¹⁴ Allenby, Greg M & Peter E Rossi, “Hierarchical Bayes Models,” in Grover, Rajiv & Marco
Vriens, eds., *The Handbook of Marketing Research*, Thousand Oaks: Sage Publications, Inc., 2006.

26 ¹⁵ Underlying the Mixed Logit is a model of random utility. Berkeley economics professor
27 Daniel McFadden developed the random utility model in the 1970s while working as a consultant on
28 the design of the Bay Area Rapid Transit (BART) system in California. This work won McFadden
the Nobel Prize in 2000. *See* Hal Varian, *Intermediate Microeconomics*, 8th Ed, 2009, Page. 68.

1 known to the consumer that the claim is not true) and the price associated with that choice. The
2 utilities are also correlated with observable characteristics of the consumers making the choice (such
3 as their age or income).

4 73. The utility of each product consists of two components – a deterministic component
5 and a random component. The deterministic component can be modeled by observable factors such
6 as socio-economic and demographic characteristics of the consumers, product features, and market
7 conditions. In general terms, the random component summarizes all the unobservable factors in the
8 individual consumer's choice process. In Mixed Logit models, the random component is expressed
9 through a logistic distribution function. Together with the observable factors, this distribution
10 function is used to predict the probability that a particular choice is made.¹⁶

11 74. Once shown a menu of choices of different levels of attributes and different price
12 alternatives, the consumer then chooses the one choice in the menu that yields the highest utility
13 from that menu of choices.¹⁷ Observing consumers' choices from various choice menus enables one
14 to estimate the relative value consumers place on one attribute over another.

15 75. Price is included as an attribute, which allows for the estimation of the value of an
16 attribute relative to price – that is, the dollar value of the willingness-to-pay for that attribute. In fact,
17 the willingness-to-pay for an attribute is the negative ratio of the attribute's coefficient to the price
18 coefficient in the underlying choice model.¹⁸

19 76. Bayesian statistics is a subset of statistics where the underlying model parameters are
20 assumed to be random variables rather than fixed quantities. Bayesian modelling is based on
21 assigning prior probability distributions to any unknown parameters. In this case, the unknown
22 parameters to be estimated are the part-worths of the attributes of a composite product derived from

23 ¹⁶ See, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Chapter 4,
24 for a detailed discussion of the use of mixed multinomial logit models in choice based conjoint
studies.

25 ¹⁷ See Figure 12 for an example of the actual layout of a choice menu where the respondent was
26 presented a menu with four choices of combinations of features and the choice of "no purchase."

27 ¹⁸ Train, Kenneth E., "Discrete Choice Methods with Simulations," Cambridge University Press;
28 2nd edition, 2009. Chapter 12 gives a detailed derivation of the Bayesian approach applied in this
report.

the choice sets in the conjoint analysis. These parameters are estimated by a technique referred to in the literature as Hierarchical Bayesian Estimation.¹⁹

77. In Hierarchical Bayes Estimation (“HBE”), the parameter estimates are derived in a two-step hierarchical approach. At the higher level, the individual consumers’ part-worths are assumed to follow a specified distribution (like multivariate normal distribution or log-normal distribution). At the lower level, it is assumed that the individual consumers’ choice probabilities can be described by a model, such as a Mixed Logit model. Initial estimates of part-worth are estimated for each study respondent to use as a starting point. New estimates are updated using an iterative process called “Gibbs Sampling” and “Metropolis Hastings Algorithms.”²⁰ This process is typically repeated thousands of times whereby in each iteration, an estimate is made for each parameter, conditional on current estimates of the others. After many iterations, this process converges to the correct estimates for each of the parameters.

78. The HBE method combines random effect specifications at the aggregate level to account for variation across individuals and specific modelling of choice probabilities at the individual level. With market simulations, the performance of competing alternatives can be evaluated.

VI. EMPIRICAL STUDY

79. The empirical study was conducted as a consumer survey, including a pre-test/pilot study, and a Choice Based Conjoint (“CBC”) study. In this section, I first discuss in general terms consumer survey methodology and then continue to describe the components of the empirical study and how they were implemented.

80. I have commissioned a survey company called Amplitude Research (“Amplitude”) to program and host the questionnaires of my design to analyze the preferences and choices of consumers who have purchased Drives within a set time period.

¹⁹ See, for example: Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Chapter 4.11, for a detailed discussion of the use of Hierarchical Bayesian Estimation in choice based conjoint studies.

²⁰ Rao, Vithala, Applied Conjoint Analysis, Springer-Verlag, 2014, Page. 168.

1 81. Founded in 2002, Amplitude Research® is one of the top mail, telephone and online
 2 survey companies serving clients throughout the United States, Canada, South America, and Asia.
 3 Clients include commercial, educational and governmental organizations. Amplitude Research® is a
 4 member of the American Marketing Association (AMA), Marketing Research Association (MRA),
 5 Interactive Marketing Research Organization (IMRO), and Marketing Research Association of South
 6 Florida, and adheres to the professional guidelines for survey companies applied by these
 7 organizations. Amplitude Research is also A+ Rated by the Better Business Bureau.²¹

8 82. Amplitude conducted the surveys as internet panel surveys. In my experience,
 9 internet-based surveys can provide reliable results and can have some advantages over other
 10 recruiting methodologies. Over the last decade, internet surveys have increasingly gained popularity
 11 and acceptance, including in litigation.

12 83. Current research suggests that the increased use of internet surveys has great
 13 advantages over other traditional methods. For instance, studies have found that computer data
 14 collection yields higher concurrent validity, with less chances of participants framing answers to
 15 attempt to please the questioner, and less random measurement error when compared to mall
 16 intercept studies and telephone surveys. Internet surveys also allow for broad geographic reach to
 17 areas where surveying via mall intercept or other face-to-face methods would not be feasible.²²
 18 Well-executed internet survey research is regularly accepted by courts.²³

19 84. Moreover, internet surveys have become a fixture in the corporate world. According
 20 to the Global Research Business Network, internet surveys now account for more than a quarter of
 21 global market and social research revenues. In many of the world's top research markets, internet
 22 surveys are now the primary means of research.²⁴

23
 24 ²¹ <http://www.amplituderesearch.com/survey-company.shtml>.

25 ²² See "Reference Guide on Survey Research," S.S. Diamond, *Reference Manual on Scientific*
 26 *Evidence*, Third Edition, Federal Judicial Center, 2011, Page 401. Additionally, online surveys have
 27 advantages in terms of efficiency and cost.

²³ "Why Online Surveys Can Be a Smart Choice in Intellectual Property Litigation," B. Isaacson
 et al., IPL Newsletter (ABA Section of Intellectual Property Law) Vol. 26, No. 3, 2008.

²⁴ <http://fortune.com/2015/09/16/online-survey-companies-law-firms/>.

1 85. The efficacy of internet studies is often furthered by survey market research firms that
2 operate large internet panels. These firms employ trained professionals who program, administer,
3 and quality control the surveys to increase the quality of the results.

4 86. A frequent point of criticism of internet surveys is the fact that they typically do not
5 conform with the requirement for statistical random samples which states that for every individual in
6 the target population, the selection probability must be a known number greater than zero and,
7 therefore, no inference can be drawn about the precision and/or margin of error of the study.

8 87. However, advanced statistical methods can be applied to compute model-based
9 confidence intervals for well-designed and well-balanced non-probability samples. In 2016, the
10 American Association of Public Opinion Research (“AAPOR”) issued a guidance paper on
11 “Reporting Precision for Nonprobability Samples”²⁵ which details approaches and reporting
12 guidelines when precision calculations are performed for non-probability samples. I discuss in more
13 detail in Section 0 how I applied the re-sampling method known as bootstrapping to obtain precision
14 estimates and approximate confidence intervals at the customary 95% level for the results from my
15 study. The bootstrapping methodology has been endorsed as a valid approach by AAPOR.

16 88. In summary, properly designed and well-executed internet surveys have increasingly
17 gained acceptance and can be used to draw valid statistical inferences about the target population.

18 89. As described above, the empirical study includes a CBC module which is designed to
19 quantify the value that consumers assign to common Drive attributes/features. Amplitude
20 administered the survey and the empirical study via an online panel. It is my understanding that
21 Amplitude follows accepted standards regarding:

- 22 a. Survey panelist recruiting;
- 23 b. Strategic partnerships with other market research firms;
- 24 c. Use of advanced software and technology;
- 25 d. Use of proprietary survey completion time tracker;

26 ²⁵ AAPOR Guidance on Reporting Precision for Nonprobability Samples -
27 [https://www.aapor.org/getattachment/Education-Resources/For-
28 Researchers/AAPOR_Guidance_Nonprob_Precision_042216.pdf.aspx](https://www.aapor.org/getattachment/Education-Resources/For-Researchers/AAPOR_Guidance_Nonprob_Precision_042216.pdf.aspx).

- e. High quality filtering system to track respondent information and respondent behavior to deliver the highest quality sample;
- f. Best practices of quality control - including removal of sign-ups who provide inconsistent demographic information, GeoIP lookups at time of registration and, most importantly, periodic use of mailed survey awards for U.S. panelists to verify street addresses;
- g. Data tabulation and recording; and,
- h. Survey participation validation.

90. As is standard survey practice for surveys used in litigation proceedings, the surveys were conducted in a “double-blind” fashion,²⁶ that is, neither the staff at Amplitude nor the respondents were aware of the survey sponsor or the ultimate intention of the survey. Additionally, the data collection and initial tabulation was automated and concurrent with answering the online questionnaire.

91. To ensure that the data generated by the survey are of the highest quality, it is my understanding that Amplitude implemented additional quality control measures:

- a. Respondents are required to enter their gender and age at the outset of the survey and if these data conflicted with the respondent information on file with Amplitude, the respondent are excluded.
- b. Respondents who indicate that they did not understand or were unwilling to adhere to the survey instructions are also screened out of the survey.
- c. Amplitude sends an individual link to the online survey by email. This link contains an embedded identification number to ensure that only invited respondents can answer the survey and that each respondent can only complete the survey once, and that only one member per household can complete the survey.
- d. The survey also includes a control measure to evaluate the extent to which respondents were involved in completing the survey. As a control, Amplitude relies on survey administration measures, which include review of each respondent's survey completion time, review of text field responses, straight-line testing, and other filtering techniques that filter automated responses and result in superior data as well as higher quality feedback.

²⁶ Diamond, Shari, S. (2012) “Reference Guide on Survey Research,” *Reference Manual on Scientific Evidence*, Committee on the Development of the Third Edition of the Reference Manual on Scientific Evidence; Federal Judicial Center; National Research Council, Pages 410-411.

92. In this survey, there was no need for a CAPTCHA²⁷ because the respondents are web panelists. To be a participant in an Amplitude survey there is no open static link on a website or web page where participants can use computer programs to take a survey. Rather, each panelist is assigned a unique login combination that is randomly generated and then clicks on a unique link to access the survey.

A. Pre-Test Study

93. The first component of my empirical study is a Pre-Test Study, which is a ‘small’ scale versions or trial runs done in preparation for the major study.²⁸²⁹ One of the many benefits of administering a pre-test study is that it might give important insights of what might happen in the main study. It may also be a reliable mechanism to narrow down the list of attributes.

94. In this context, “attributes” refers to characteristics of the Seagate Drives such as capacity, connectivity, portability, reliability, warranty price, etc. Each attribute has at least two levels – where level refers to the values that an attribute can take; e.g., the attribute “warranty” could have two levels (yes/no) while the attribute price could have five levels which means that there are five different prices in the conjoint study.

95. Survey research literature gives the following reasons for conducting pilot studies:³⁰

- a. Developing and testing adequacy of research instruments,
- b. Assessing the feasibility of a (full scale) study,
- c. Establishing whether the sampling frame and techniques are effective,
- d. Identifying logistical problems which might occur using proposed methods,
- e. Estimating variability in outcomes to help determine sample size, and
- f. Collecting preliminary data.

²⁷ A CAPTCHA (an acronym for "Completely Automated Public Turing test to tell Computers and Humans Apart") is a type of challenge-response test used in computing in general and in market research in particular to determine whether or not the user is human.

²⁸ Polit, D.F., Beck, C.T., Hungler, B.P. (2001) Essentials of Nursing Research: Methods, Appraisal, and Utilisation (5th ed.). Philadelphia: Lippincott.

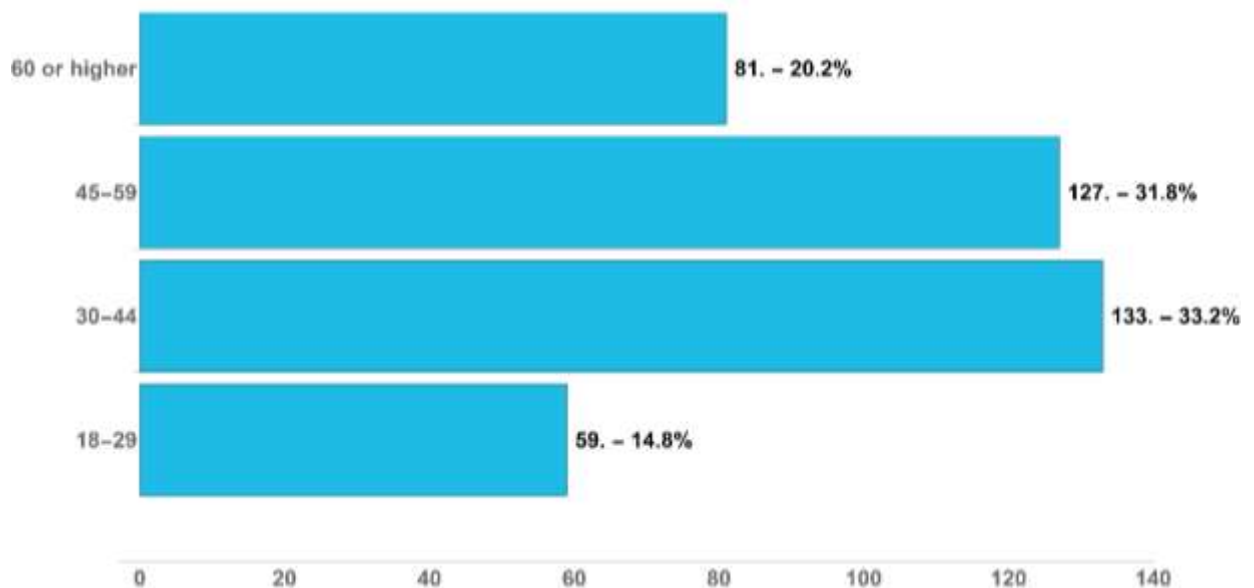
²⁹ Baker, T. L. (1994), Doing Social Research (2nd ed.), New York: McGraw Hill Inc.

³⁰ De Vaus, D.A. (1993), Surveys in Social Research (3rd ed.), London: UCL Press.

96. As part of the Pre-Test Study 400 respondents completed a survey in which they were asked about the importance of product features of hard-drives. Respondents were only included in the survey if they met the following criteria:

- a. Respondent is 18 years or older;
- b. Respondent resides in the United States;
- c. Respondent has purchased an internal or external hard drive in the past six years;
- d. Respondent is not working in market research.

97. 49% of respondents were male and 51% were female. Figure 11 shows the age distribution of the respondents.



Source: Pre-Test Study.

Figure 11: Age Distribution of Respondents in the Pre-Test Study

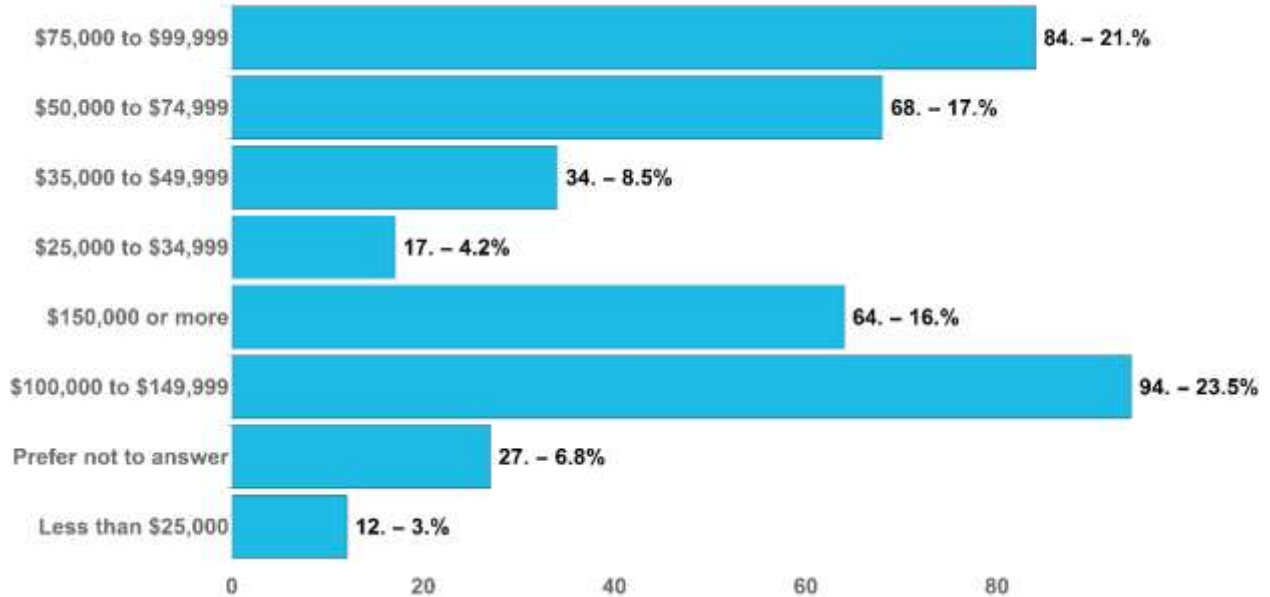
98. Figure 12 shows the regional distribution of the respondents in the Pre-Test Study.



Source: Pre-Test.

Figure 12: Regional Distribution of the Respondents in the Pre-Test Study

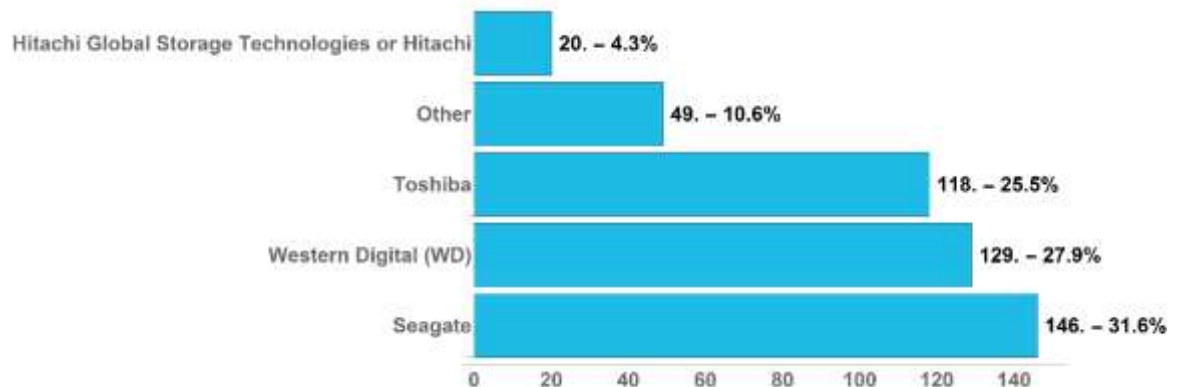
99. Figure 13 shows the income distribution of the respondents in the Pre-Test Study. Most respondents have a household income of \$100,000 to \$149,000, followed by \$75,000 to \$99,999. The relatively high average household income also indicates that the purchasers of external and internal hard drives are relatively well-to-do and older individuals.



Source: Pre-Test.

Figure 13: Income Distribution of the Respondents in the Pre-Test Study

100. Figure 14 shows the brand of the most recent hard drive purchase by the respondents in the Pre-Test Study. Seagate has a share of 32%, followed by Western Digital (28%) and Toshiba (26%).

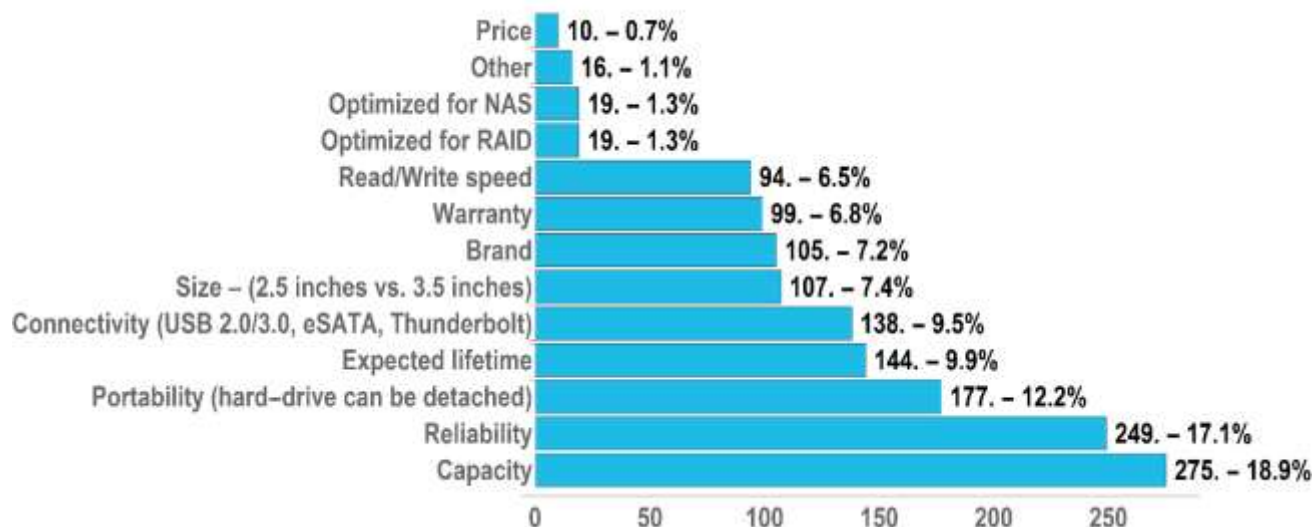


Source: Pre-Test Study.

Figure 14: Most Recent Brand Purchased by Respondents in the Pre-Test Study

101. Respondents were asked to select which attributes of hard drives were important to them. Multiple selections were possible. The question also included a category "Other".

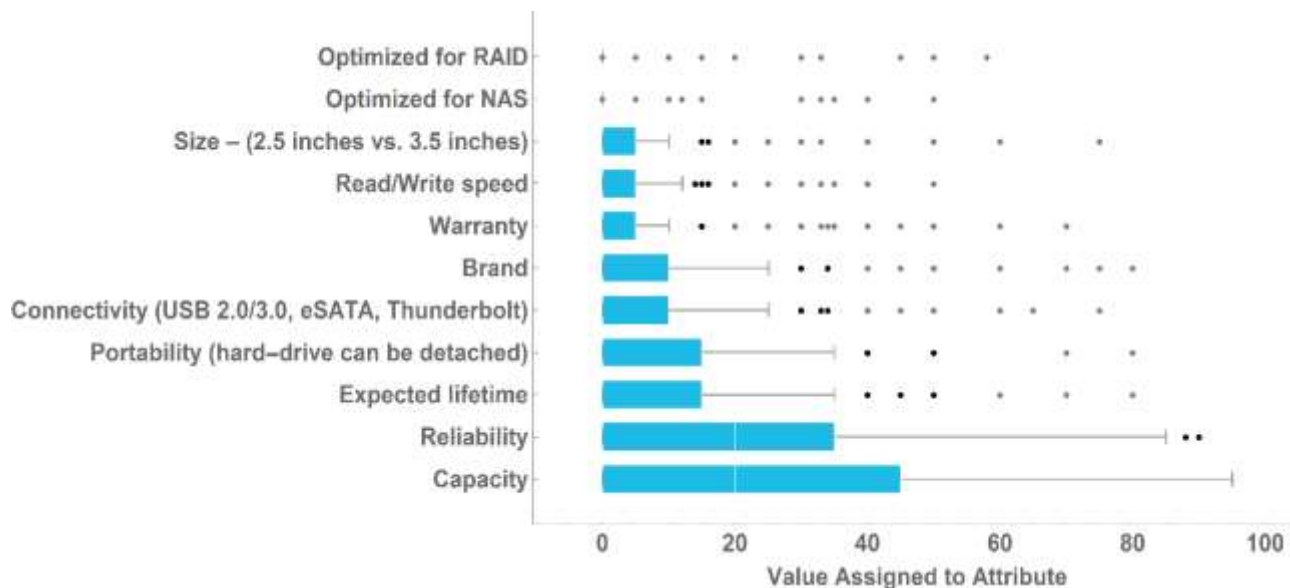
Respondents, who selected “Other”, then could respond to an open-ended question and name additional categories. Price had not been listed as one of the attributes but was mentioned by 10 respondents in the open-ended question. Figure 15 summarizes the responses. Capacity is the most frequently named feature, followed by reliability.



Source: Pre-Test Study.

Figure 15: Drive-Attributes Chosen by Respondents in the Pre-Test Study

102. In the next step respondents were asked to assign weights to each of the attributes they had listed in response to the previous question. Figure 16 summarizes the results. Capacity is the most important attribute. Respondents assigned values between 0 and 95 to this attribute, while 95% of respondents selected a weight of between 0 and 45. The median value assigned by respondents is 20. Capacity is followed by reliability and expected lifetime. One has to note that these two attributes are closely related. Reliability could be expressed in expected lifetime and vice versa.



Source: Pre-Test Study.

Figure 16: Importance of Drive-Attributes

103. Based on the results of the Pre-Test Study, I selected the following attributes for the Conjoint Survey:

- a. Capacity – this attribute was offered in the Conjoint Study at a level of 3 TB.
- b. Annual Failure Rate (AFR), reflecting the attributes reliability and expected lifetime in the Pre-Test Survey;
- c. Warranty;
- d. Connectivity; and
- e. Price.

B. Choice Based Conjoint Study

104. The second component of my empirical study is comprised of the Choice Based Conjoint analysis based on a survey of 2,000 consumers. I divided the 2,000 respondents into a test group of 1394 purchasers of Seagate Drives and a control group of 606 purchasers Drives from competing brands like WD, Hitachi, and Toshiba.

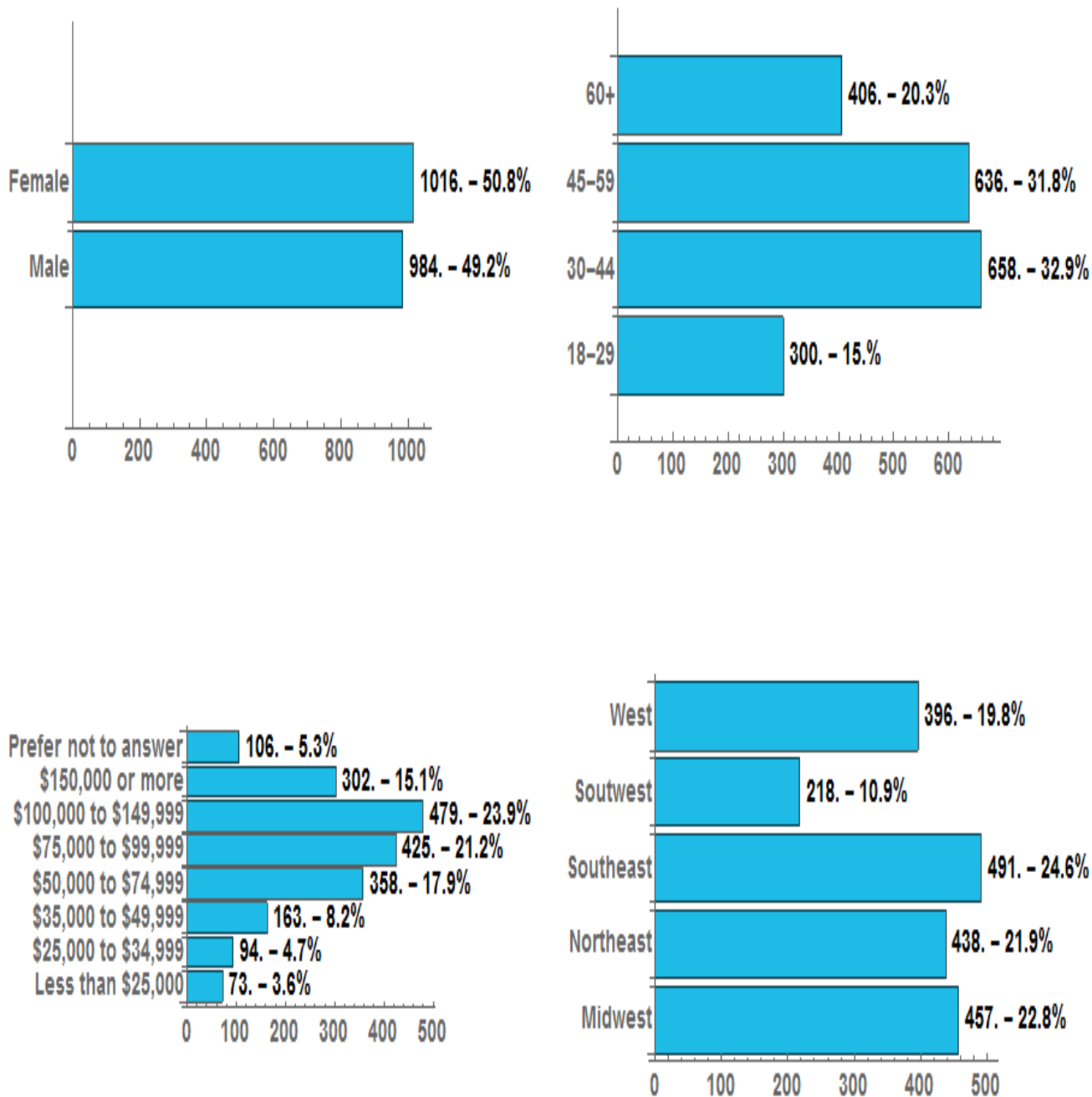
105. Using Amplitude's access to large online consumer panels, I was able to target a demographically diverse group of respondents who have been recent purchasers of Seagate and competing brands. When recruiting survey participants, Amplitude employs a method of balancing

1 the survey participants based on demographics and socio-economic factors such as gender, age,
2 income, and geographical region.

3 106. Amplitude applied the same filter criteria as in the Pre-Test Study. Respondents were
4 only included in the survey if they met the following criteria:

- 5 a. Respondent is 18 years or older;
- 6 b. Respondent resides in the United States;
- 7 c. Respondent has purchased an internal or external hard drive in the past six years;
- 8 d. Respondent is not working in market research.

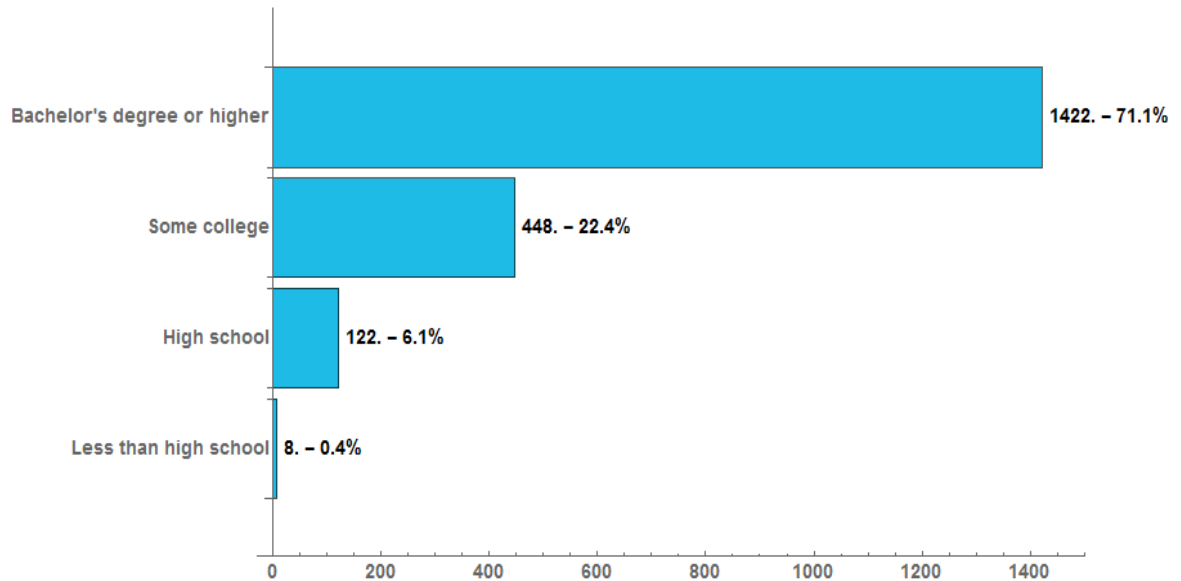
9 107. Amplitude replicated the demographics of the Pre-Test Survey with respect to gender,
10 age, income and geographical region. Figure 17 shows these quota for each respective demographic
11 attribute.



Source: Conjoint Survey.

Figure 17: Survey Quotas by Gender, Age, Income & Geographical Region

108. Most survey respondents had a Bachelor's degree or higher (Figure 18).



Source: Conjoint Survey.

Figure 18: Educational Attainment of Survey Respondents

109. After qualifying for the survey, the participants respond to questions designed to elicit their thoughts about Drives. Further, they disclosed which brand they bought most recently, and which attributes are important to them when making purchasing decisions (e.g., price, brand, etc.).

110. Neither the respondents nor the company administering the survey (Amplitude) had any information on the context of the study or who commissioned it and are not informed that the data would be used in litigation, or more specifically, in a lawsuit against Seagate.

111. The next section of the survey was comprised of the actual CBC exercise itself. During this exercise, respondents viewed a discrete number of choice sets, each containing a combination of discrete number of attributes, plus a price. The attributes and respective levels are given by:

- a. Capacity – this attribute was offered in the Conjoint Study at a level of 3 TB.
- b. Annual Failure Rate (AFR), reflecting the attributes reliability and expected lifetime from the pre-test/pilot study – the levels for this attribute are:
 - i. 1% or less;
 - ii. 10%;
 - iii. 25%; and
 - iv. 50%.

Based on these failure rates I used interpolations to derive part-worths for failure rates of 2% to 10% in 1 percentage point increments.

c. Warranty – the levels for this attribute are:

- i. No additional warranty;
- ii. 1-year additional warranty; and
- iii. 2-year additional warranty.

d. Connectivity/Portability – the levels for this attribute are:

- i. Internal – not configured for NAS;
- ii. Internal – configured for NAS but not RAID; and
- iii. Internal – configured for NAS and RAID.
- iv. External – USB2;
- v. External – USB3; and
- vi. External – eSATA.

e. Price – the levels for this attribute are: \$29, \$59, \$89, \$119, and \$149.

112. Three considerations determined the boundary of this range:

- a. Generally, the price range should cover realistic prices for the product. For example, a price of \$1 would not be realistic as the typical retail price is far higher. Similarly, a price of \$1,000 would not be realistic as well.
- b. Prices can be higher or lower than the prices of currently offered products as we test product attribute combinations that might not yet be available in the market.
- c. In the case that we test the impact of false and misleading advertising, we determine the price for a product without the advertised claim, which is currently not available in the market. Hence, in order to estimate a demand curve for the product without the advertised claim, we need to include prices both below and above the price points common in the market.

In my opinion, the price range from \$29 to \$149 complies with these considerations.

113. The CBC employed in the survey randomly assigns choices from all possible choices³¹ with equal likelihood and with uniform frequency of each level of each attribute and each pair of attribute/level permutations. That is, the CBC design is *balanced* and *orthogonal*. Balanced and orthogonal surveys are commonly employed in CBC.³² The importance of an orthogonal and balanced design lies in the fact that designs of this type are 100% efficient. Efficiency implies that the resulting estimations have the smallest mean squared error out of all possible designs.³³ The mean squared error measures the level of variation and as such, the precision of the resulting estimates. The smaller the mean squared error of an estimate the more precise it is. As such, efficiency of a design is a measure of the information content of a design. Therefore, more efficient designs imply more reliable results.³⁴

114. Each choice set consists of five choices: four with various combinations of product attributes and prices as described in Paragraph 104 above. After each survey choice respondents had to confirm whether they would have purchased the selected product or not. An example of a choice set is given in Figure 19 below.³⁵ Each participant responded to 12 such screens. Each screen showed randomly selected levels for each attribute. Therefore, Figure 19 does not necessarily show all levels for each attribute. Note that respondents were instructed that the hard drive at question would be a 3TB drive. Therefore, the conjoint analysis does not include variations of the capacity of the hard drive.

³¹ The four levels for the AFR attribute, three levels for the warranty attribute, the six levels for the portability and connectivity attributes, and the five levels for the price attribute yield a total of $4 \times 3 \times 6 \times 5 = 600$ different possibilities of combining the different levels of the attributes in the study.

³² Bakken, David & Curtis L Frazier, "Conjoint Analysis: Understanding Consumer Decision Making," in Grover, Rajiv & Marco Vriens, eds., *The Handbook of Marketing Research*, Thousand Oaks: Sage Publications, Inc., 2006, Chapter 15.


³³ The mean squared error (MSE) is calculated as the average of the squared distances between the estimator and what is estimated, or the "errors." Efficient designs are ones that minimize the MSE.




³⁴ The standard error is the standard deviation of the sampling distribution of a statistic. A smaller standard error implies a smaller margin of error, which results in a tighter confidence interval around an estimate.

³⁵ Each of the 2,000 participants in the CBC responded to 12 screens with five choices yielding a total of $2,000 \times 12 \times 5 = 72,000$ data points for the statistical analysis.

Survey Progress:

Which of these options would you be most likely purchase?

For definitions and more information or if you feel unsure about a concept, please hover your mouse over the .

	Option 1	Option 2	Option 3	Option 4	Option 5
Annualized Failure Rate (AFR) 	50%	10%	50%	Less than 1%	10%
Extended Warranty 	Additional year	Additional year	Additional year	No additional warranty	Additional year
Portability & Connectivity 	Internal specifically designed for NAS with RAID	Internal specifically designed for NAS with RAID	External with USB3	Internal not designed for NAS	Internal specifically designed for NAS but without RAID
Price	\$119	\$59	\$119	\$119	\$89
Which option would you prefer?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[CONTINUE>>](#)

Source: Conjoint Survey.

Figure 19: Example of the CBC Choice Menu

115. It is a known phenomenon that choices presented earlier in a list of choices in a questionnaire are disproportionately likely to be selected.³⁶ This phenomenon is known as order bias. To avoid order bias in my study, attributes were shown in a different order, chosen at random, to each respondent – except for price, which was always shown last.

VII. ECONOMIC LOSS CALCULATION

A. Four-Step Estimation Process

116. A purchaser of a Seagate Drive that contains for example a claim of an AFR of <1% that was alleged in the Complaint to be false, actually paid for the Drive expecting to receive a product where the advertised claim was true but in fact received an inferior product. I designed a choice based conjoint study to assess if giving the consumer the information at the point of purchase that the claim of an AFR<1% is false will lead to a downward shift of the demand curve.

³⁶ Krosnick, Jon and Duane Alwin, “An evaluation of a cognitive theory of response order effects in survey measurement,” Oxford Journals Social Sciences Public Opinion Quarterly Volume 51, Issue 2, Pages. 201-219.

117. I apply the following four-step estimation process to determine the economic loss associated with purchasing a product where the claim although made, turns out to be false:

- a. Step 1: Based on the results from the CBC analysis, compute individual utilities for each respondent for each attribute and each level in the study
- b. Step 2: Construct the demand curves for the Seagate Drives in the actual-world and the but-for-world.
- c. Step 3: Quantify the drop in consumer demand and the corresponding economic loss that the purchasers experienced because they were unaware at the point of purchase that the claim is false.
- d. Step 4: Conduct market simulations to assess the drop in demand for a large variety of product combinations.

118. In Step 1, I utilized a software program called Sawtooth to compute utilities for the attributes and the levels for each attribute in the study. The Sawtooth software applies the Hierarchical Bayesian Estimation technique³⁷ to compute individual utilities for each respondent and aggregate utilities for all levels and attributes in the study. The Sawtooth software allows to specify the models in different ways. One important feature is a constraint that specifies the model in a fashion that higher prices are always associated with a lower utility.

119. This so-called monotonicity constraint refers to a property of the utility estimates - without the monotonicity constraint the utility estimates may yield higher numerical values for levels that seem to be lower in utility for some individuals, and thus seemingly indicate “illogical” consumer choices.

120. However, this behavior can be explained by the fact that the “rational economic consumer” is only a postulate or an assumption in theoretical economics while in the “real” world not all variables affecting consumer choices can be measured, and as a consequence, consumers often do exhibit seemingly irrational behavior. For example, I may stop at a gas station that charges \$0.20 more per gallon because I am already running late on my way to work and this particular gas station is the one I can get to easily without detour. While it may seem irrational to pay more for gas, the convenience factor in this example cannot be measured and quantified.

³⁷ See Section V.B above.

1 121. The Sawtooth software allows to “smoothen” the utility estimates in a way that higher
2 price levels for a specific attribute combination are always associated with a lower utility value. This
3 feature ensures that “illogical” consumer choices are ruled out when a monotonicity constraint is
4 built into the model. When using a monotonicity constraint, the demand curves are smoother, and
5 therefore, the resulting market simulations have fewer extreme data points making the damages
6 estimates on average lower. In this report, I ran all models with and without the monotonicity
7 constraint.

8 122. In Step 2, the utility estimates are applied to construct the demand curve for the
9 product when the advertised claim is believed to be true by the consumer at the point of purchase.
10 Further, I construct the demand curves for the other levels for an attribute of interest. For example, I
11 construct the demand curves for a product with a falsely advertised AFR of less than 1% and
12 potential actual AFR’s of 5%, 8%, and 10%.³⁸

13 123. In Step 3, I quantify the drop in consumer demand and the new equilibrium price.
14 Based on the degree of the downward shift of the demand curve, I can then calculate economic
15 damages to the members of the putative class based on their purchase of the Drive with the false
16 claim.

17 124. In Step 4, I conduct market simulations to assess if economic damages exist is a wide
18 variety of market conditions.

19 **B. Market Simulations in Conjoint Analyses**

20 125. To assess the robustness of the willingness-to-pay estimation under a variety of
21 market conditions, I performed a comprehensive market simulation study using the individual
22 utilities that I have estimated from the conjoint study using the Hierarchical Bayesian Estimation
23 methodology. In my market simulations, I use the attributes and levels defined in the conjoint study.
24
25

26 ³⁸ At the time of the survey, the exact observed AFRs of the Drives were not yet available.
27 Therefore, I included in the conjoint survey AFR’s of less than 1%, 10%, 25% and 50%. I derived
28 part-worths for AFRs between 1% and 10% through interpolation. In the merit phase a conjoint
survey could include AFRs that reflect the AFRs observed in this case.

1 126. The Hierarchical Bayesian Estimation of the parameters of the underlying Mixed
2 Logit choice model yields estimates of individual part-worth utilities for each respondent for each
3 level of all attributes in the conjoint study.

4 127. Market simulations are an important tool to convert the part-worths from the conjoint
5 study into monetary measures reflecting consumer preferences and choices. In general, different
6 permutations of product attributes and levels of those product attributes are applied in a market
7 simulation to assess the respondents' choice probabilities for different combinations of product
8 attributes and the resulting economic loss.

9 128. In general, conjoint studies lead to a set of utilities or part-worths that quantify
10 respondents' preferences for each level of each attribute. These utilities can be analyzed to assess
11 how the respondents react to changes in the product attributes at different price points.

12 129. The market simulation consolidates the preferences and choices for all respondents
13 which enables to answer questions about preference and likelihood of choice when attributes and
14 levels of product attributes are changed.

15 130. The knowledge of individual respondents' utilities for product attributes and their
16 levels in combination with their price utilities, market simulations are also a useful tool to estimate
17 demand curves for products with varying attributes as well as shifts in demand curves when product
18 attributes change.

19 131. By using the individual part-worths, it is possible to determine the demand curve for
20 any specific combination of product attributes and their levels for different price points. When the
21 question needs to be answered if and how the change in the level of a particular attribute changes the
22 demand curve then two demand curves can be calculated – the first one for a specific set of levels
23 and attributes and a given price and the second one where the product attributes and price are
24 identical but one level of one attribute is different. The measured shift in the demand curve, if any,
25 can then be attributed to the changed level. Based on the change in demand curves, if any was found,
26 it is then possible to determine the change in price that would be necessary to reach the same demand
27 for the product where a level in one of the attributes was changed.

C. Quantification of Economic Loss Based on Conjoint Analysis Supported by Market Simulations

132. The estimated willingness-to-pay using this method is derived from the utility that respondents gain from purchasing a Seagate Drive that makes one or more of the claims mentioned in the Complaint compared to obtaining an otherwise identical Seagate Drive that does not make those claims. To be clear, this value is *not* an average value that would be different for all class members – rather, it is the equilibrium price calculated based on consumers’ responses to varying choice menus in the Conjoint Analysis designed to derive one numerical figure to value the claim. The interpretation of this figure is the amount consumers paid when purchasing a Seagate Drive product making certain claims compared to an otherwise identical Seagate Drive without such claims.

133. The conjoint analysis allows the researcher to estimate a demand curve for a specific combination of attributes. Based on the monotonic property of the price utilities, interpolation between the price-market share combinations allows to estimate the demand curve for market shares from 0 to 100 and every price between a discrete range. A change in the level of one or more of the attributes would result in a different demand curve.

134. *Ceteris paribus*, when we assume the but-for-world where the consumer is told about the falsity of certain claims, the levels of the attributes change, and the Seagate Drive becomes less attractive to consumers and the demand curve shifts downward.

135. In economic theory, a negative price is associated with bads – the opposite of goods.³⁹ In simple terms, the consumption of a bad is associated with negative utility for the consumer, which will be reflected in the consumer’s willingness-to-pay. A simple example will illustrate the concept of an economic bad in context of price and willingness to pay: Let’s assume that a vendor operates a stand at mile marker 13 during a marathon race where she sells bottles of water for \$5 and that this vendor is the only one selling water bottles at mile marker 13. The bottles of water at the price of \$5 constitute the supply of water bottles at that particular location. All runners who at that moment in time would assign a subjective value greater than or equal to \$5 to the bottle of water will become

³⁹ Hal R. Varian, *Intermediate Microeconomics*, 8th Edition, 2009, Page 41.

1 purchasers while all runners who at that moment in time would assign a subjective value smaller than
2 \$5 to the bottle of water will not purchase the bottle of water. Therefore, the subjective value itself
3 does not matter and does not need to be measured accurately. The fact that one runner may assign a
4 subjective value of \$100 is completely irrelevant because this runner will pay the asking price of \$5.

5 136. Let's now assume that the bottles sold by the vendor really contain clear vinegar and
6 the vendor would tell the runners that the label on the bottle indicating that it is water in the bottles is
7 wrong because the bottles really contain vinegar. It can safely be assumed that in the situation of a
8 marathon race vinegar is a less desirable liquid and the demand curve for vinegar would be
9 downward shifted from the demand curve for water.

10 137. Every runner who paid \$5 for the bottle labeled as "water" which actually contained
11 vinegar suffered an economic loss. However, the loss is not calculated as the difference between the
12 assigned subjective value of the water bottle and the assigned subjective value of the bottle filled
13 with vinegar. Much rather, the economic loss is the difference between the price paid (i.e., \$5) for the
14 bottle and the price that would have been paid for a bottle of vinegar in this situation.

15 138. While vinegar may be perceived as an economic good with a positive utility
16 associated with its consumption, it is entirely possible that there would not be any demand for a
17 bottle of vinegar during a marathon race and vinegar would turn from an economic good into an
18 economic bad. Therefore, the true market value of a bottle of vinegar is irrelevant if the consumers
19 have been led to believe that they are purchasing water.

20 139. In cases where consumers view a product as an economic bad (like a bottle of vinegar
21 during a marathon race), the economic loss suffered can be equal to or larger than the purchase price.
22 Therefore, the argument that large values for the economic loss would render the damages model
23 unreliable is simply incorrect and unfounded. We all know the colloquial expression "You would
24 have to pay me money to buy that" – this expression has a theoretical foundation in economic theory
25 and a technique like choice based conjoint analysis can be utilized to quantify the economic loss.
26
27
28

1 140. As shown in theory in Figure 10, in order to make consumers whole after they had
2 been harmed by false advertising, we need to shift the demand curve in the but-for world vertically
3 into the actual demand curve.

4 141. The market simulation results show the market share for a Seagate Drive that is
5 advertised with all their claims and sold at set price in the actual-world. The conjoint analysis
6 indicates that the same Seagate Drive but without the claims would presumably require a much lower
7 price to achieve the same market share. This result would clearly indicate that the removal of the
8 attributes represented by the claims will have turned the product into a bad for the marginal
9 consumer. As a hypothetical example, if a product had a failure rate of 50% within the first six
10 months after purchase, the consumers' utility may drop so steeply that the new equilibrium price in
11 the but-for-world could be negative which means that in economic terms this product is a bad.

12 142. In my market simulations, I have varied the levels of attributes, and prices resulting in
13 a discrete number of possible combinations. For each attribute combination, I compute two demand
14 curves to assess if a drop in the demand curve results in an economic loss for a set of price points.

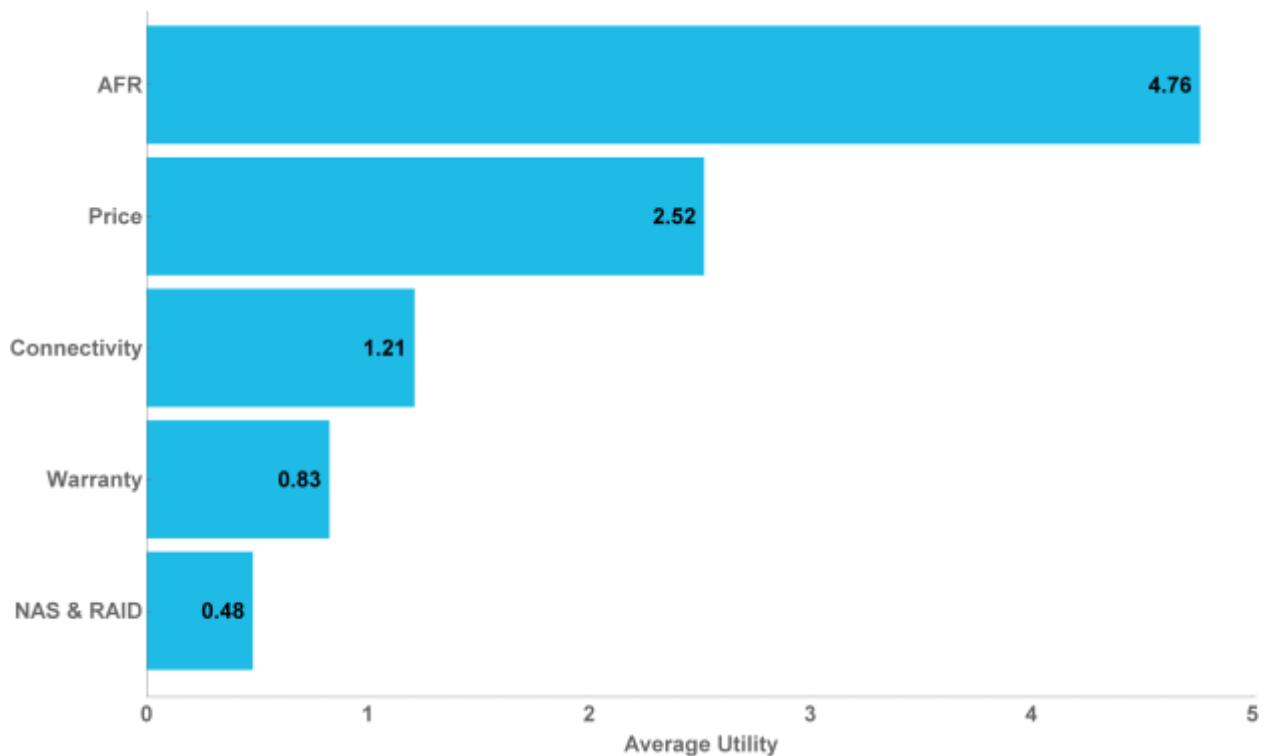
15 143. The consumption of a bad is undesirable and it creates negative utility for consumers.
16 Therefore, more consumption as measured in higher market share of a product that is a bad will
17 further decrease the negative utility and can thus increase the economic loss beyond the actual price
18 of the product.

19 **D. Study Results**

20 144. The attribute utility analysis measures the relative importance of each attribute in the
21 overall attribute bundle. The attribute utility value for a given attribute is computed by subtracting
22 the least favorable level of the attribute (for example highest AFR) from the most favorable level of
23 the attribute (lowest AFR) for each respondent. We then compute the average of the differences over
24 all respondents.

25 145. The attribute utility value allows to rank the attributes of a given conjoint exercise and
26 to compare on an ordinal level the different attributes. The conjoint analysis reveals that the Annual
27
28

Failure Rate (AFR) is by far the most important attribute, followed by price and warranty terms. NAS and RAID are valuable to respondents but far less than the annual failure rate (Figure 20).



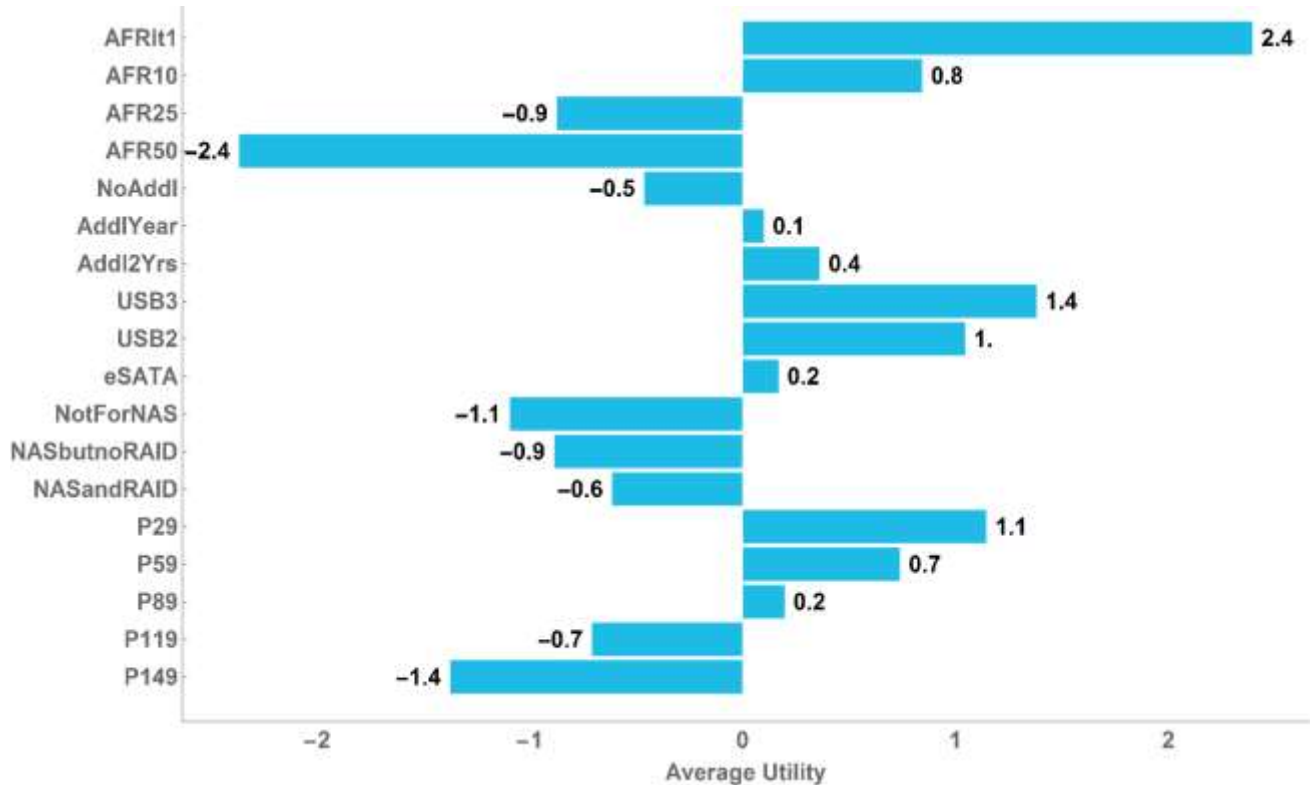
Source: Conjoint Survey.⁴⁰

Figure 20: Attribute Utility Analysis, Seagate Users Only – Monotonicity Constraint

146. The attribute utility analysis provides an overall summary of the relative value of the attributes covered in the conjoint module. As can be seen in Figure 20, AFR is the attribute with the highest perceived utility to the purchaser, even larger than price. For attributes with a larger utility than price, there is typically a threshold level within that attribute for which the utility turns negative which implies that the economic loss can be equal to or even exceed the purchase price once the attribute drops below the threshold level. The results of my market simulation scenarios which are described in Paragraphs 148 and 149 and illustrated in Figures 22 and 23, indicate the level of AFR at which the economic loss will be equal to the purchase price of the Drive.

⁴⁰ In addition to the model with monotonicity constraint for purchasers of Seagate hard drives, the Appendix to this report includes the following additional models: (1) purchasers of Seagate hard drives – no monotonicity constraint, (2) purchasers of other brands with monotonicity constraint, (3) purchasers of other brands without monotonicity constraint.

147. Within an attribute, the average utilities by level add up to zero enabling to model the relative utility or lack of utility of the different levels for each attribute. For example, in Figure 21, the average utility for prices \$29, \$59, \$89, \$119 and \$149 add up to zero.

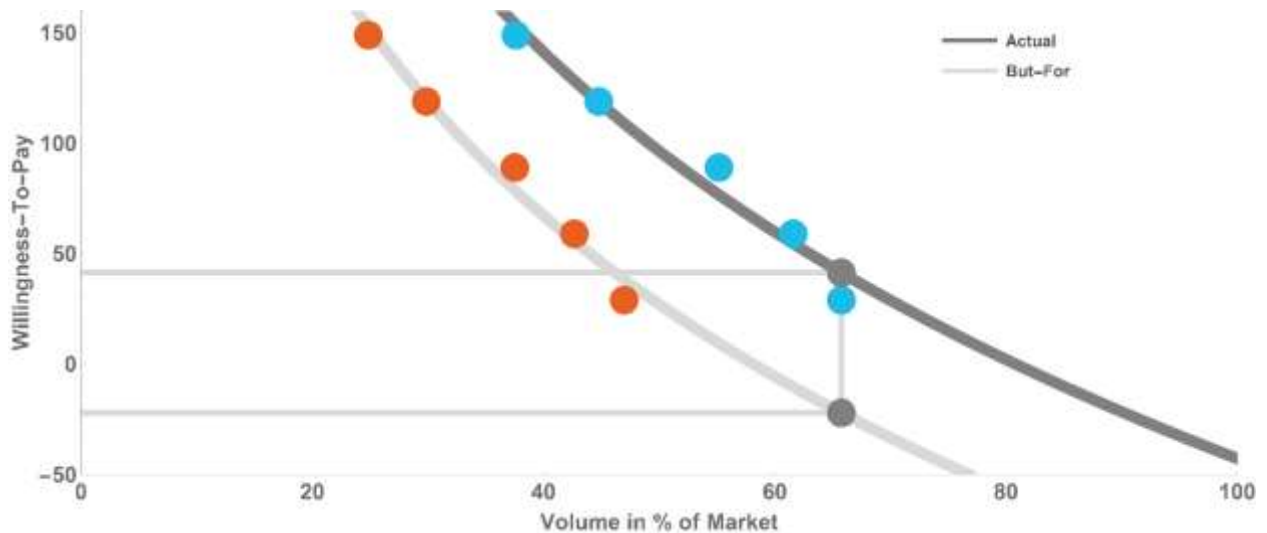


Source: Conjoint Survey.

Figure 21: Level Utility Analysis, Seagate Users Only – Monotonicity Constraint

148. The part-worth for by level and attribute for each respondent allow us to estimate the share of all respondents who would purchase a product constructed from a permutation of all attribute levels for a given price. By varying the price, we can then construct a demand curve for that product. The blue dots in Figure 22 show the demand for a Seagate hard drive with eSATA connectivity, one year warranty, an AFR of less than 1% and the price levels in descending order from left to right of \$149, \$119, \$89, \$59 and \$29. The dark gray line is the demand curve fit through the price-volume combinations predicted by the CBC model. The orange dots in Figure 22 show the demand for the same hard drive specification but an AFR of 10%. Because this hard drive is less desirable than the hard drive with an AFR of less than 1%, the demand curve is shifted to the left. If in the actual world 67% of the respondents would have bought the hard drive at \$49, had the

respondents been informed at the point of purchase that the AFR was 10% rather than less than 1%, it would require a compensation of \$54 to reach the market equilibrium in the actual world.



Source: Own Analysis based on Conjoint Survey conducted by Amplitude.

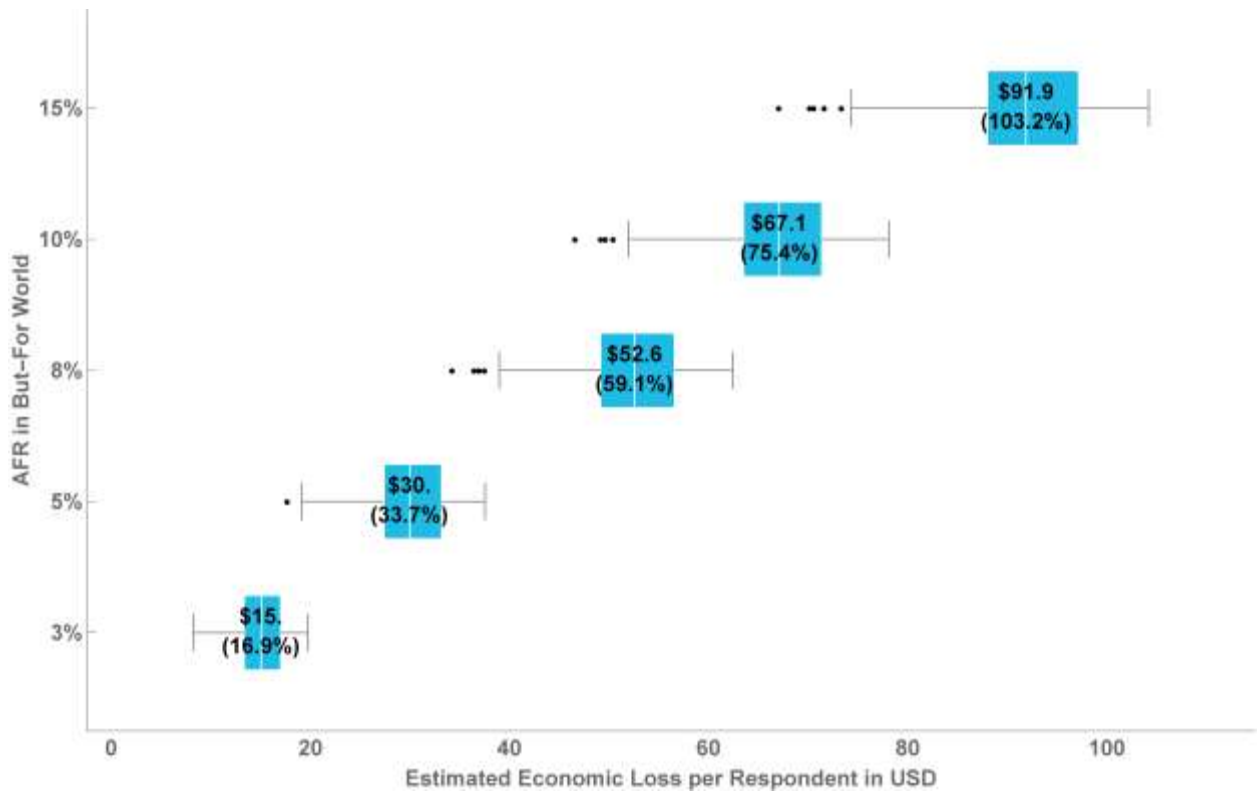
Figure 22: Actual and But-For Demand for a Specific Hard Drive

149. The box-plot in Figure 23 shows the distribution of the economic loss for five different scenarios with respect to the but-for world⁴¹: Instead of the advertised AFR of less than 1%, the true AFR is (i) 3%, (ii) 5%, (iii) 8%, (iv) 10%, or (v) 15%. The bars on the thin line show the minimum and maximum economic loss for each scenario, while the solid blue box represents the inner quartile range which is a statistical measure that captures 50% of all the data points. The black dots show outliers. The number in the center of each solid blue box shows the respective median economic loss. For example, if the actual AFR is 10% the estimated economic loss per unit ranges from \$47 to \$78 with a median of \$67.1. In the case of an actual AFR of 10%, the median economic loss of \$67.1 is 75.4% of the median price (\$89).

150. The fact that the minimum economic loss in all simulated scenarios is greater than zero is empirical proof that class-wide economic damages do exist and can be measured by this approach. Figure 23 further illustrates how this method can be utilized to find the threshold at which consumers would no longer buy the product – this is simply the AFR for which the economic loss

⁴¹ It has to be pointed out that the model developed, implemented, and discussed in this Declaration allows for the specification of economic losses for all incremental AFRs between 1% and 50%. The results in Figure 23 and Figure 24 display only a subset.

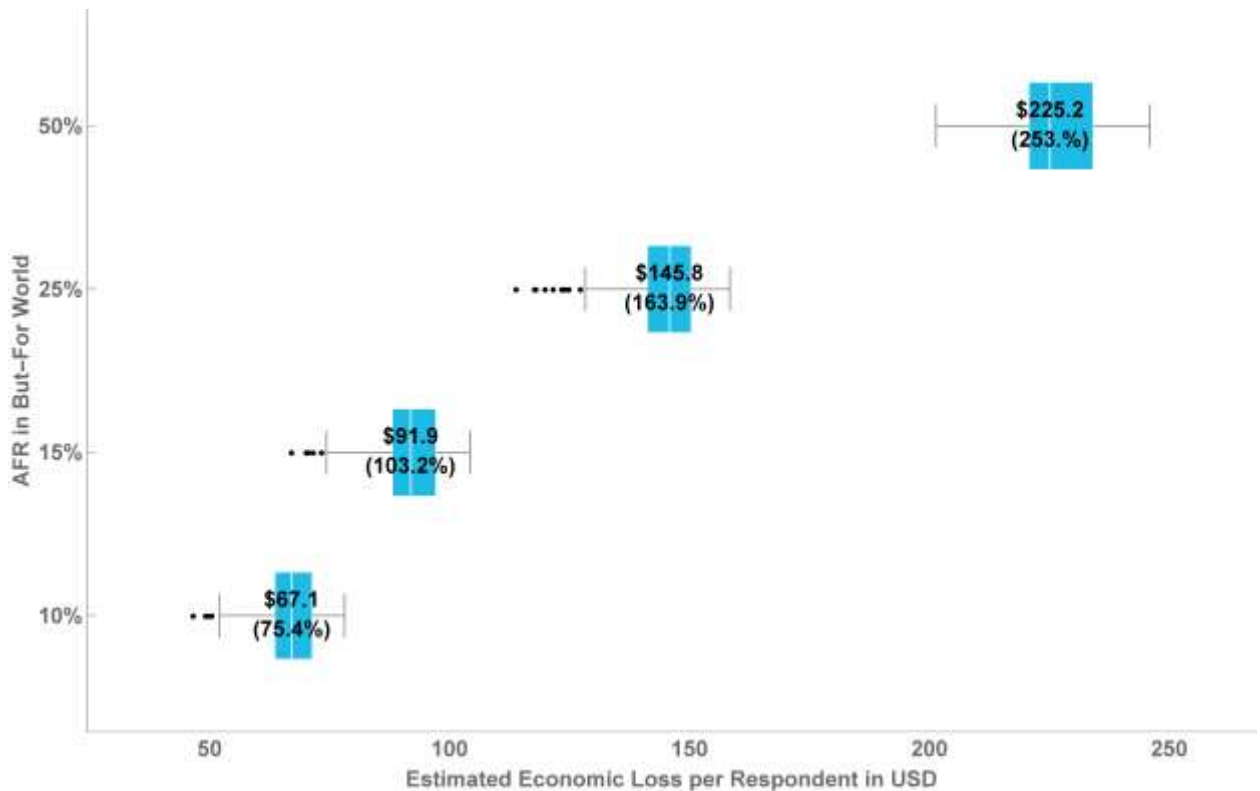
exceeds the median purchase price. In this case, an AFR of 15% yields an economic loss of 103.2% of the median price (\$89) in the market simulations. Therefore, an AFR of slightly below 15% is the threshold for which the economic loss would be the entire purchase price.



Source: Own Analysis based on Conjoint Survey conducted by Amplitude.

Figure 23: Point Estimates of Economic Loss Based on Simulation – Seagate Users Only – Monotonicity Constraint

151. The box-plot in Figure 24 shows the distribution of the economic loss for four different scenarios with respect to the but-for world: Instead of the advertised AFR of less than 1%, the true AFR is (i) 10%, (ii) 15%, (iii) 25%, or (iv) 50%, or (v) 15%. The data in Figure 24 clearly indicate that for larger AFRs the consumer's loss increase dramatically. For example, if the AFR is 25% then the economic loss will be equal to 163.9% of the purchase price which is an indication that a Drive with a 25% AFR is perceived by the consumer as an economic bad. As explained above, an economic bad can be colloquially expressed as "You would have to pay me money to buy a Drive with a 25% AFR."



Source: Own Analysis based on Conjoint Survey conducted by Amplitude.

Figure 24: Point Estimates of Economic Loss Based on Simulation – Seagate Users Only – Monotonicity Constraint

E. Confidence Interval for the Point Estimates

152. The facts that (a) the minimum economic loss estimate across all market simulations is greater than \$0 of all estimated loss scenarios and that (b) the median⁴² economic loss of each market simulation is statistically significant is empirical proof of the existence of class-wide economic losses.

153. The study I designed is not a statistical random sample in the sense that the selection probability for each participant is a known number greater than zero. However, the identification of the sample frame, the selection process of participants from the sample frame, and utilizing

⁴² The median (also called the 50th percentile) in a distribution of data points is the value for which 50% of all data points in that distribution are smaller or equal to while the other 50% of all data points in that distribution are greater or equal to that value. In more general terms, the nth percentile of a distribution is defined as the value in a distribution of data points where n% of all data points are smaller than or equal to that value. For example, the 90th percentile of a distribution is defined as the value in that distribution of data points where 90% of all data points are smaller than or equal to that value.

1 demographic information as balancing weights makes the resulting sample a representative selection
2 from the target population.

3 154. In full acknowledgement of the fact that the selection probability for each participant
4 will not be a known number greater than zero and as such, the resulting survey is strictly speaking a
5 non-probability sample, I adhere to the AAPOR⁴³ “Guidance on Reporting Precision for
6 Nonprobability Samples.” In its guidance, AAPOR discusses several approaches that survey
7 researchers use to estimate precision with nonprobability samples:

8 “AAPOR encourages researchers to implement the approach that is
9 most appropriate for the study design. While not an exhaustive list,
10 four commonly used approaches for quantifying the precision of
11 statistical estimates include: resampling approaches, Bayesian credible
12 intervals, Taylor series linearization, and application of the simple
random sample (SRS) formula for margin of error. For each approach,
there are certain pieces of information that a statistically-trained,
independent observer would need to know in order to evaluate the
study’s design and the resulting estimates.”⁴⁴

13 155. I follow the format of reporting the results of my precision computations as suggested
14 in the AAPOR Guidance:⁴⁵ To estimate the precision of the estimates from the survey and construct
15 95% approximations to confidence intervals, I drew 100 random samples of 1900 observations or
16 95% of the total survey population. I then compute the percentiles of the point estimates for the
17 economic loss for each scenario in my market simulation. Each bootstrapping iteration yields a
18 different point estimate for the economic loss. I then tabulate all results from all re-sampling
19 iterations. Finally, I determine the 2.5th and 97.5th percentile of the derived distribution. In Footnote
20 41 above, the nth percentile of a distribution was defined as the value in that distribution for which
21 n% of all data points in that distribution are smaller than or equal to that value. Based on this
22 definition, the percentiles can be used to calculate approximate confidence intervals in the following
23 way: The 2.5th percentile is the value in the distribution for which 2.5% of all data points are smaller

24 ⁴³ AAPOR is an acronym for the American Association of Public Opinion Research. See
25 <https://www.aapor.org> for more information. I am a member of AAPOR.

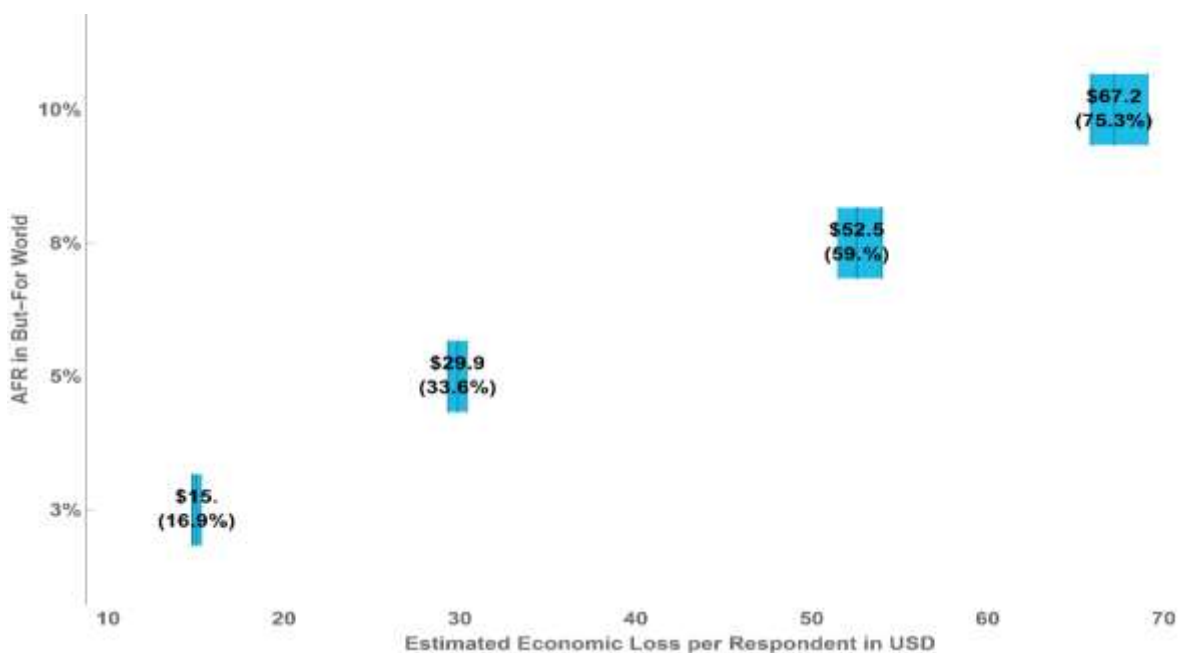
26 ⁴⁴ AAPOR Guidance on Reporting Precision for Nonprobability Samples, Page 1.
27 [https://www.aapor.org/getattachment/Education-Resources/For-
Researchers/AAPOR_Guidance_Nonprob_Precision_042216.pdf.aspx](https://www.aapor.org/getattachment/Education-Resources/For-Researchers/AAPOR_Guidance_Nonprob_Precision_042216.pdf.aspx).

28 ⁴⁵ *Ibid.* Pages 2 and 3.

than or equal to and the 97.5th percentile is the value in the distribution for which 97.5% of all data points are smaller than or equal to. I calculate the approximate 95% confidence intervals for all market simulations.

156. The margins of error and the levels of statistical confidence indicate if the preferences and choices of the participants in the empirical study show a large degree of homogeneity when assessing the economic value of the claims at issue in this case.

157. Figure 24 shows the results of the bootstrapping analysis for each market simulation that was conducted for AFR values of 3%, 5%, 8%, and 10%.⁴⁶ Each bar represents an approximate 95% confidence interval for the respective median value. The small width of the confidence intervals indicates high precision⁴⁷, and thus high reliability of the results. The median economic loss per purchaser is shown in absolute value and as a percent of the median purchase price.



Source: Own Analysis based on Conjoint Survey conducted by Amplitude.

Figure 25: Confidence Interval for Median Economic Loss at Different Annual Failure Rates

⁴⁶ A complete list of approximate 95% confidence intervals including lower bounds, upper bounds, and approximate margin of error in tabulated format can be found in the Appendix.

⁴⁷ For example, the confidence interval for the 10% AFR economic loss estimate of \$67.2 ranges from \$65.9 to \$69.1 which is a margin of error less than +/- 2.5%.

158. RAID and NAS do not rank as high in the importance scale. When modelling the impact of false advertising with respect to RAID and NAS in isolation, economic losses can be measured. However, when modelling false advertising with respect to AFR, RAID and NAS combined, the impact of RAID and NAS is small. Furthermore, the incremental impact of RAID and NAS on economic losses falls within the bounds of the confidence interval for the economic losses related to AFR.

159. For failure rates in excess of 10%, the economic loss quickly approaches the sales price of the product and for failure rates approaching 20% and larger than 20% the product is perceived by the consumer as a bad which can be seen by the results of the market simulations I performed. Should the Court decide that the class members should receive a full refund rather than a damage based on their economic loss as estimated above, I will develop a model of class-wide economic loss by multiplying annual retail sales for each SKU with the average retail price for the SKU in the respective year.

VIII. SUMMARY AND CONCLUSION

160. I developed a theoretical model that shows how the demand for a product changes when attributes and levels of attributes for that product change. To quantify the change in demand when the attributes of the product change (e.g., when claims about the product are false and misleading), I designed a choice based conjoint study.

161. I applied the well-established scientific methodology of Mixed Logit modeling and Hierarchical Bayesian Estimation to analyze the data from the efficiently designed choice based Conjoint Analysis. The results from the conjoint analysis can be relied upon to draw inferences about the value of claims to customers at the point of purchase and how such value will change when the claims are revealed to be false at the point of purchase.

162. The conjoint analysis shows what respondents would have paid for a product with none of the attributes falsely claimed, to compute if they suffered an economic loss when the Court decides that the claims at issue were all found to be false and misleading.

1 163. Lastly, I conclude that the method proposed and described in this report can be used
2 to expand the results of the conjoint study to a complete model to calculate class-wide damages in
3 the merits phase of this case by multiplying the economic loss per unit as established above with the
4 number of units purchased by class members during the class period. In addition, the model proposed
5 in this Report to compute class-wide economic losses can be expanded in the merits phase of this
6 case to incorporate additional aspects if the Court deems this necessary.

7 164. The analysis and opinions contained in this report are based on information available
8 as of the date of this report. I reserve the right to supplement or amend this report in the event
9 additional information becomes available.

10 165. I declare under penalty of perjury under the laws of the United States that the
11 foregoing is true and correct. Executed this 20th day of November, 2017, at Los Angeles, CA.

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16 Stefan Boedeker
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APPENDIX -RESULTS OF CONJOINT ANALYSIS FOR DIFFERENT SUB-SAMPLES

Purchasers of Seagate Hard Drives – No Monotonicity Constraint

Purchasers of Other Hard Drives – Monotonicity Constraint

Purchasers of Other Hard Drives – No Monotonicity Constraint

Table Appendix 1: Approximate 95% Confidence Intervals for Median Economic Loss With Price Constraints

Conjoint	But-For World AFR	2.5 % Lower Bound	Median	97.5 % Upper Bound
<i>All But Seagate</i>				
	3%	13.5	15.0	16.4
	5%	27.0	30.0	32.9
	8%	46.2	52.2	59.7
	10%	58.6	66.5	74.0
	15%	84.7	91.4	98.7
	25%	127.1	144.6	167.8
	50%	195.0	223.0	260.4
<i>Seagate Only</i>				
	3%	14.8	15.0	15.3
	5%	29.3	29.9	30.4
	8%	51.5	52.6	54.0
	10%	65.9	67.2	69.1
	15%	90.1	91.8	94.2
	25%	142.1	145.9	150.8
	50%	218.7	225.1	233.1

Table Appendix 2: Approximate 95% Confidence Intervals for Median Economic Loss Without Price Constraints

Conjoint	But-For World AFR	2.5 % Lower Bound	Median	97.5 % Upper Bound
<i>All But Seagate</i>				
	3%	14.7	16.4	18.6
	5%	29.9	32.7	36.1
	8%	51.9	57.4	64.7
	10%	64.4	73.3	85.5
	15%	89.7	102.2	116.7
	25%	145.6	167.2	195.7
	50%	223.9	266.0	326.7
<i>Seagate Only</i>				
	3%	16.2	16.5	17.0
	5%	32.1	32.9	33.9
	8%	56.9	58.0	59.5
	10%	72.3	74.0	76.5
	15%	100.0	102.8	106.7
	25%	161.8	167.8	174.2
	50%	260.1	268.4	281.4

Exhibit A



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Education

- BS in Statistics,
University of Dortmund, Germany
- BA in Business Administration
University of Dortmund, Germany
- MS in Statistics
University of Dortmund, Germany
- MA in Economics
University of California, San Diego
- Met Ph.D. requirements except
dissertation in Economics,
University of California, San Diego

Professional Associations

- Member of the American Economic Association (AEA)
- Member of the American Statistical Association (ASA)
- Member of the Econometric Society
- Member of the Mathematical Association of America (MAA)
- Member of the American Association for Public Opinion Research (AAPOR)
- Member of the Market Research Association (MRA)
- In 2001 Stefan was a member of an AICPA task force dealing with Corporate Integrity Agreements (CIA). Stefan was responsible for issues related to statistical methodology utilized in CIA's.

Background

Stefan is a Managing Director at Berkeley Research Group where he focuses on the application of economic, statistical, and financial models to a variety of areas such as solutions to business issues, complex litigation cases, and economic impact studies. He has extensive experience applying economic and statistical theories and methodologies to a wide variety of cases where But-for-scenarios have to be developed based on probabilistic methods and where statistical predictive modeling has to be applied to assess liability and damages.

Stefan has applied these techniques in business disputes, single-plaintiff cases, multi-plaintiff cases, and class action proceedings in the areas of class certification, liability assessment, developing damages scenarios, and post settlement or judgment distributions.

Professional and Business Experience

Representative Engagements

Litigation

- » In a class action alleging misleading advertising practices, Stefan performed statistical analyses in the class certification stage.
- » For a major healthcare provider involved in a dispute with a potential class of more than 3,000 other providers over allegedly excessive outlier payments Stefan performed economic and statistical analyses. Ultimately, class certification was denied in that case.
- » In a class action alleging discriminatory allocation of public funds by a large metropolitan transportation authority, Stefan performed statistical analyses of transportation data.
- » In a multi-plaintiff case against a state authority on improper funding of special education programs, Stefan performed statistical analyses of funding related ledger data.
- » In a class action alleging improper practices of charges for gym memberships, Stefan performed statistical analyses in the class certification analysis. Based on the analysis, the ultimately certified class was significant smaller than initially defined. In this case, Stefan also developed statistical models to assess damages.



- » In a class action alleging losses to consumers due to faulty window regulators in automobiles, Stefan utilized statistical models to assess economic damages.
- » In a class action against a large financial institution alleging fee overcharges for personal trust accounts, Stefan utilized statistical analyses to segment the account holders and ultimately reduce the size of the class.
- » In a class action case where a provider of a used car evaluation model was ordered by the court to test if their model did not significantly undervalued cars, Stefan performed statistical analyses.
- » In a class action case over fee overcharges in the payment process of car insurance, Stefan developed a distribution model of repayments to class members after a settlement had been reached.
- » In a class action of home owners over alleged diminution of property values due to proximity to a plume of contaminated soil, Stefan performed statistical analysis to assist counsel in a motion against class certification.
- » In a natural resource damage class action case, Stefan provided econometric analysis of property value loss due to proximity to a solid waste site utilizing hedonic regression models.
- » For a class action case involving potential damage from a landfill in a state park, Stefan analyzed data about travel, tourism and park attendance. Stefan specified and estimated linear regression models and time series models to predict park attendance.
- » In a class action case involving alleged diminution of property values due to ground-water contamination, Stefan specified and estimated hedonic regression models to show that other factors than the contamination contributed significantly to the loss in property value.
- » In a class action against a large financial institution alleging non-payment of coupon payments for bearer bonds Stefan designed and administered large-scale databases to reconstruct accounting records of a large financial institution's Corporate Trust Department. He developed statistical models to analyze bondholders' presentment behavior of Bearer bonds.
- » In a class action dispute between the Department of Interior and individual Native Americans over mismanagement of individual trust accounts, Stefan performed a statistical analysis of an electronic database with approximately 60 million records in order to draw a statistically valid sample of accounts for further analysis.
- » In a trademark infringement case of video equipment, Stefan calculated damages based on the defendant's unjust enrichment utilizing statistical time trend models.
- » For a shareholder derivative action against a leading publicly-traded health care provider, employed an econometric approach to quantify potential damages per share due to alleged section 10b-5 violations and other claims. For the same matter, developed a multi-trader model to estimate the number of shares potentially damaged.
- » In a dispute between a major health care provider and private payor groups, Stefan developed statistical stratified sampling models to assess exposure across different contract types.



- » For a large financial institution's personal trust department involved in a consumer class action, Stefan designed a random sample to estimate the potential exposure due to fee overcharges.
- » For a computer equipment leasing company involved in an employee class action, Stefan utilized statistical models to estimate exposure due to alleged forfeiture of unpaid vacation time in a class action of former and current employees.
- » For a limousine company involved in a wage and hour class action, Stefan developed a statistical sampling based exposure model to quantify the impact of alleged unpaid overtime and missed meal breaks.
- » In several cases involving 12 hour shift workers at hospitals Stefan performed rebuttal analyses of plaintiff's damages computations.
- » For a large electronic retail chain Stefan calculated exposure based on the failure of paying overtime for store managers.
- » For a major department store Stefan performed a statistical analysis of manager surveys where he found significant differences in the managers' allocation of time across department and stores. Ultimately, due to these differences a class was not certified.
- » For a large sporting goods retail chain Stefan assisted in defining the size of the potential class and in estimating the potential exposure which led to a favorable, early settlement of the case.
- » For a women's shoes retail chain Stefan designed and statistically analyzed an observational study to quantify the amount of time spent on exempt versus non-exempt tasks.
- » For a video rental store chain Stefan developed sampling algorithms based on in-store security cameras to analyze time spent by assistant managers on exempt versus non-exempt activities.
- » For a large fast food chain Stefan directed a team collecting employee work information from restaurant locations in order to monitor and gain compliance in response to litigation
- » For a large mass merchandiser Stefan developed a document and data reconciliation tool and he developed a statistical sampling mechanism to proof compliance with a court ordered document retention procedures in the course of a wage and hour litigation.
- » Stefan worked with a Fortune 500 bank in a class action suit to review the claims of managers that were misclassified and should have been paid overtime. To compute damages, Stefan reviewed the overtime records of employees in this position prior to a job classification change and, in the absence of overtime data after the job classification change, Stefan reviewed sign in and sign out times of the office building.
- » For a long-term care provider Stefan used data from timesheets, payroll, and other scheduling records to create comprehensive reports showing potential exposure for each of the claimed areas: timely wage payment, overtime wage payment, adequate daily meal and rest break periods, and travel time compensation.



- » For a maternity clothing store chain Stefan performed analyses related to exempt/non-exempt status issues for managers and assistant managers. Stefan also conducted a break time analysis for all employees.
- » For a commercial flooring contractor Stefan assessed the job duties and responsibilities of a group of supervisors. During the engagement, the scope of work expanded to include an analysis of misclassification and back-pay exposure for additional groups of employees.
- » For a software developer Stefan analyzed how department and project specific characteristics impacted the work flow and the correlation of that impact to certain exemptions.
- » For a large meatpacker Stefan conducted a time and motion study to properly assess the duration of certain separately compensated activities to rebut allegations of violation of minimum wage laws.
- » For a public university housing department Stefan conducted an extensive time and motion study to identify the tasks (and associated time range to perform each task) related to processing a contract cancellation.
- » For a large drugstore chain Stefan used in-store cameras for the smaller stores and actual in-store observations for the larger stores to conduct a time motion study and quantify the time spent by assistant managers on certain pre-defined tasks.
- » For a large public storage company Stefan conducted a detailed time and motion study to determine the cost of collection and administration of late payments. Using both self-logging and independent review techniques, Stefan defined each step in the late payment process, calculated the cost to the company for such activities, and compared this cost to the late fees under dispute.
- » For a large retail store chain Stefan performed statistical analyses of regularly conducted employee activity surveys.
- » For a mass merchandiser, Stefan conducted an observational study of activities of all individuals classified as managers to show significant differences in daily activities.
- » For a department store, Stefan conducted an in-store observational study of managers and assistance managers to assess the percentage of time spent on managerial tasks.
- » For a state ferry system in the Pacific Northwest, Stefan conducted an observational study of engine room personnel during shift changes to quantify potentially unpaid time worked.
- » For a large retail chain Stefan conducted an extensive analysis of the company's compliance with break time rules and regulations and also the employees' usage and potential abuse of break time.
- » For a large mass merchandise retailer Stefan compiled a comprehensive database of punch clock data, payroll data, point of sales data, hardcopy information about manual edits of time entries, store security system data, etc. to analyze allegations of inserting breaks, deleting time and forcing employees to work after they clocked out.



- » For a large electronic retail chain Stefan analyzed time card data, point of sales data and other store specific attributes to quantify potentially missed meal and rest breaks.
- » In a gender discrimination case involving a client in the food processing industry, Stefan analyzed the impact of the implementation of an Affirmative Action Plan on the allegedly discriminatory employment practices.
- » In a class action case alleging age discrimination for a vegetable seed company, Stefan performed rebuttal work of the plaintiff's expert's liability and damages analysis.
- » In a class action case alleging age discrimination for a major aerospace company, Stefan performed statistical analyses to rebut allegations of age discrimination.
- » In a class action race discrimination suit against the Alabama Department of Transportation, Stefan developed statistical regression models and tests to analyze the alleged discrimination.
- » In a class action gender discrimination case against a large real estate brokerage firm, Stefan provided deposition testimony to class certification issues.
- » In a gender discrimination case against a temporary employment agency, Stefan performed econometric analyses to disprove salary discrimination against two former female employees. Stefan addressed plaintiffs' expert's damages calculations and developed alternative scenarios.
- » For a large meat processing plant, Stefan performed statistical analyses of employment data to address allegations of discriminatory hiring practices.
- » For a leading publicly-traded developer of enterprise management software, Stefan employed a statistical approach to demonstrate the diversity of investment styles among proposed lead plaintiffs for a securities class action lawsuit alleging section 10b-5 violations and other claims. For the same matter, Stefan employed an econometric approach to estimate potential damages for each lead plaintiff.
- » For a leading publicly-traded developer of enterprise management software, Stefan employed an econometric time-series model to analyze allegations of insider trading and the timing of certain stock transactions relative to information available to officers in the company.
- » For a shareholder derivative action against a leading publicly-traded health care provider, employed an econometric approach to quantify potential damages per share due to alleged section 10b-5 violations and other claims. For the same matter, developed a multi-trader model to estimate the number of shares potentially damaged.
- » For a publicly-traded manufacturer of office supplies, developed a Black-Scholes application and utilized a binomial distribution probability methodology to evaluate the appropriateness of the size of a loan loss reserve related to a loan collateralized by the assets of an employee stock purchase plan.
- » For a large software developer, Stefan performed statistical modeling to assist in a securities class action litigation involving allegations of improper revenue recognition, reserve allocations, financial statement disclosures and other accounting irregularities



- » For a failed computer hardware company in defense of a 10b-5 securities litigation action, Stefan performed statistical analyses of accounting transactions, inventory and receivable reserves and the auditor's work papers in its evaluation of the allegations.
- » In several Rule 10b(5) class actions, Stefan used the event study approach to calculate the value line of a security. In these cases Stefan applied complex and advanced one, two, and multi-trader models.

Non-Litigation

- » For large grocery store chains, Stefan analyzed the effectiveness of a frequent shopper card program utilizing data mining techniques. He also analyzed customer data to facilitate the introduction of one-to-one marketing tools.
- » For a grocery store chain, Stefan utilized econometric elasticity models to recommend pricing strategies for in-store promotions.
- » For a grocery store chain, Stefan developed customer segmentation models to design segment specific marketing campaigns.
- » For the American Film Marketing Association, Stefan performed an economic impact study of the influence of the independent film producers and distributors on the U.S. economy in general, and the California economy in particular.
- » For a large entertainment client, Stefan developed statistical models to predict the return of video cassettes and DVDs.
- » For several clients in the retail industry, Stefan developed statistical models to estimate the liability of unredeemed gift certificates.
- » For a client in the restaurant business, Stefan developed statistical models to quantify the dollar amount of outstanding unredeemed gift certificates.
- » For a major hotel chain, Stefan developed statistical models to forecast the redemption of frequent traveler program points for tax purposes.
- » For a high profile e-commerce company, Stefan's team produced an interactive business decision tool to forecast company growth and profitability. The interactive model allows the client, through the choice of a few fundamental inputs, to measure the simultaneous impact on all cost and revenue dimensions of the company, including real estate and equity participation.
- » For the Nevada Resort Association, Stefan quantified the economic impact of the gaming industry with special emphasis on the accelerated population growth in greater Las Vegas.
- » For the Los Angeles Unified School District, Stefan performed an economic study about the impact of different recycling programs.



- » For the Los Angeles County Department of Health Services, Stefan conducted a time and motion study to determine the time required to complete specific Medi-Cal eligibility and provider forms.
- » For the Arizona Tax Research Association, Stefan developed economic models to quantify the revenue impact of a proposed change of taxation in the construction sector in Arizona.
- » For a hotel property management company, Stefan analyzed customer data, and used data mining methods to develop predictive models for customer acquisition, retention, and attrition.
- » For a project analyzing the extent of competition in the market segments of a pipeline company, Stefan estimated regression and Tobit-models to determine optimal bidding behavior for gas storage demand. He prepared testimony given in filings before the Federal Energy Regulatory Commission (FERC).
- » For a hotel property management company, Stefan developed a demand driven yield management system.
- » For a company providing self-storage space, Stefan developed a demand driven price-setting strategy utilizing own- and cross-price elasticity regression models.
- » For a high-tech start-up with a unique service offering of new products, Stefan recommended product-pricing scenarios.
- » For a large international conglomerate, Stefan developed customized data mining techniques for the implementation within a customer knowledge management system.
- » For a large law firm, Stefan performed a comprehensive statistical analysis of Los Angeles Superior Court jury verdicts over the last decade. The project tested the hypothesis of systematic bias in particular courthouses with respect to plaintiff-win probability, length of trial, length of deliberation, and dollar amounts awarded.

Depositions & Testimony

Depositions

1. MRO Communications, Inc vs. American Telephone and Telegraph Company, United States District Court District of Nevada, Case. No. -5-95-903-PMP, Deposition Testimony, September 26, 1996
2. Yolanda Aiello Harris, individually and on behalf of all others similarly situated; Jennifer Hopkins, individually and on behalf of others similarly situated; Shannon L. Bradley, individually and on behalf of others similarly situated, Plaintiffs, vs. CB Richard Ellis, Inc., a California corporation; CB Commercial INC., a California corporation; Defendants, Superior Court of California, County of San Diego, Case No. GIC 745044, Deposition Testimony, January 5, 2001.



3. State of Tennessee, ex rel., Douglas Sizemore, Petitioner vs. Xantus Healthplan of Tennessee, Inc., Chancery Court of Davidson County, Tennessee at Nashville, Case No 99-917-II, Deposition Testimony, October 11, 2001.
4. Howard Wright, Inc., a California corporation doing business as AppleOne Employment Services, Plaintiffs, vs. Olsen Staffing Services, Inc., a Delaware Corporation, Dagny Smith, an individual, Vicky Riechers, an individual, and Linda Shiftman, an individual, Defendants, Superior Court of the State of California for the County of Los Angeles, Case No. BC 200657, Deposition Testimony, December 7, 2001.
5. Sacred Heart Medical Center, et al., Plaintiffs, -vs- Department of Social and Health Services, and Dennis Braddock, the Secretary of the Department of Social and Health Services, Defendants, Superior Court of the State of Washington in and for the County of Thurston, No. 00-2-01898-1, Deposition Testimony, January 23, 2003.
6. Patrick Bjorkquist individually and on behalf of all others similarly situated, Plaintiff, vs. Farmers Insurance Company of Washington, Defendant, in the Superior Court of the State of Washington for King County, Case No.: 02-2-11684-1 SEA, Deposition Testimony, November 3, 2003.
7. Diversified Property, a general partnership, Dora Saikhon Family Trust, and Nancy Saikhon Borrelli, an individual, Plaintiffs vs. Manufacturers Life Insurance (U.S.A.), a Michigan corporation, erroneously sued as Manufacturers Life Insurance Company, Inc., Defendants in the Superior Court of California, County of San Diego, Case No.: GIC 815128, Deposition Testimony on July 21, 2004.
8. Alan Powers, Plaintiff, vs. Laramar Group et al., Defendants in the United States District Court, Northern District of California, No. C-02-3755 SBA, Deposition Testimony on August 27, 2004.
9. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Deposition Testimony on February 9, 2005.
10. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Deposition Testimony on March 11, 2005.
11. Fujitsu v. Cirrus Logic et al., United States District Court, Northern District of California, San Jose Division, Case No. 02CV01627. Deposition Testimony on April 21 and 22, 2005.
12. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Deposition Testimony on May 18, 2005.
13. Perez et al. v. RadioShack Corporation, United States District Court, Northern District of Illinois, Eastern Division, Case No. 02-CV-7884, Deposition Testimony on December 13, 2005.
14. United States of America ex rel. A. Scott Pogue v. American Healthcorp Inc., Diabetes Treatment Centers of America Inc., et al., United States District Court, Middle District of Tennessee at Nashville, Civil No. 3-94-0515, Deposition Testimony on May 12, 2006.
15. School Districts' Alliance v. State of Washington, United States District Court, Eastern District of Thurston, Case No. 04-2-02000-7, Deposition Testimony on July 20, 2006.



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17. Boca Raton Community Hospital, Inc., a Florida not-for-profit corporation d/b/a Boca Raton Community Hospital, on behalf of itself and on behalf of Class of all others similarly situated v. Tenet Healthcare Corp., a Nevada Corporation, United States District Court, Southern District of Florida, Miami Division, Case No. 05-80183-CIV-SEITZ/MCALILEY, Deposition Testimony on October 13, 2006.
18. Louise Ogborn v. McDonald's Corporation et al., Commonwealth of Kentucky 55th Judicial District, Bullitt County Circuit Court, Case No. 04-CI-00769, Deposition Testimony on October 19, 2006.
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20. Norman Utley, et al., v. MCI, Inc., MCI Worldcom Communications, Inc., and MCI Network Services, Inc., formerly known as MCI Worldcom Network Services, Inc., United States District Court, Northern District of Texas, Dallas Division, Civil Action No. 3:05 - CV- 0046 - K, Deposition Testimony on May 30, 2007.
21. Ramon Moreno and Ernesto Morailo, on behalf of themselves and all others similarly situated v. Guerrero Mexican Food Products Inc., a division of Gruma Corporation; and Gruma Corporation, a Nevada Corporation, United States District Court, Central District of California, Case No. CV05-773RSWL(PLAx), Deposition Testimony on August 10, 2007.
22. Darensburg et al. v. Metropolitan Transportation Commission, U.S. District Court, Northern District of California, Case No. C-05-1597-EDL, Deposition Testimony on March 18, 2008.
23. In Re: King Pharmaceuticals, INC, Derivative Litigation, Lead Case No: BOO19077(M), The Chancery Court, Sullivan County at Bristol, Tennessee, Deposition Testimony on April 4, 2008.
24. P. Ansley et al. v. Lewis Homes of California, a California General Partnership, et al., Superior Court of the State of California, For the County of Solano, Case No. FCS02445, Deposition Testimony on April 10, 2008.
25. Personnel Plus v. Ashish Wahi et al., Superior Court of the State of California, County of Orange, Case No. 07CC08363, Deposition Testimony on August 13, 2008.
26. First Capitol Consulting Inc. v. LVX, Inc. et al., Superior Court of the State of California for the County of Los Angeles, Case No. BC378202, Deposition Testimony on October 27, 2008.
27. R. Molina et al. v. Lexmark International, Inc., Superior Court of the State of California for the County of Los Angeles, Case No. BC339177, Deposition Testimony on November 19, 2008.



28. In re National Century Financial Enterprises, Inc. Investment Litigation, No. 2:03-MD-1565-JLG-MRA (S.D.Ohio), Deposition Testimony on January 22, 2009.
29. New York City Employees' Retirement System, et al. v. Bank One, N.A., et al., Case No. 03-cv-09973 (LAK) (S.D.N.Y.), Deposition Testimony on January 22, 2009.
30. Dole Fresh Fruit International, Ltd, Hyundai Precision America, Inc., JAMS Arbitration, ADRS Case #05-1138-RTA, Deposition Testimony on December 21, 2009.
31. D. Berry, L. Hedges et al. v. Volkswagen of America, Inc. In The Circuit Court of Jackson County, Missouri, at Independence, No. 0516-CV01171 Division 2, Deposition Testimony on February 18, 2010.
32. D. Aberle et al. v. Davidson Builders, Inc., et al., Superior Court of the State of California, County of Orange, Case No.: 37-2008-00083718-CU-CD-CTL, Deposition Testimony on March 24, 2010.
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37. M. St. Croix, et al. v. Cedar Fair, L.P., et al., Superior Court of California, County of Orange, Case No. 30-2008-0214500, Deposition Testimony on August 22, 2011.
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39. Cathleen McDonough, et al., v. Horizon Blue Cross/Blue Shield of New Jersey, United States District Court, District of New Jersey, Civil Action No. 09-cv-00571-(SRC) (PC), Deposition Testimony on January 10, 2012.
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41. Ameritox, Ltd., v. Millennium Laboratories, Inc., United States District Court, Middle District of Florida, Case No. 8:11-cv-00775-SCB-TBM, Deposition Testimony on December 20, 2013.
42. United States of America, ex rel. Glenda Martin v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:08-CV-251, Deposition Testimony on January 15, 2014.



43. United States of America, ex rel. Tammie Taylor v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:12-CV-64, Deposition Testimony on January 15, 2014.
44. Darren Smith, et al., v. Panera Bread Company, Superior Court of California, County of San Diego, Case No. 37-201-00084077 CU-BT-CTL, Deposition Testimony on April 30, 2014.
45. Joseph Hummel et al., v. Castle Principles, LLC et al., Superior Court of California, County of Santa Clara, Case No. 112CV223170, Deposition Testimony on June 19, 2014.
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48. Oracle Wage and Hour Cases, Raghunandam Matam et al., v. Oracle Corporation, Superior Court of California, County of Alameda, No. RG-09480164, Deposition Testimony, October 21, 2014.
49. G. Taylor et al. v. Shippers Transport Express, Inc., et al., United States District Court, Central District of California, Case No.: CV13-02092-BRO (PLAx), Deposition Testimony on October 24, 2014.
50. Denise Mays et al. v. Children's Hospital of Los Angeles, Superior Court of California, County of Los Angeles, Case No. BC477830, Deposition Testimony on March 17, 2015.
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60. Christian Juarez, et al v. Dignity Health, a California corporation, et al., Superior Court of the State of California, County of Los Angeles, Central Civil West District, Case No. BC550950, Deposition Testimony on August 15, 2016.
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63. United Healthcare Insurance Company v. Lincare Inc., Case Improvement Plus of Texas Insurance Company: Care Improvement Plus South Central Insurance Company: Care Improvement Plus of Maryland, Inc. v. Lincare Inc., In An Arbitration Before the American Arbitration Association, Case No. 01-15-0003-4095, Deposition Testimony on December 21, 2016.
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65. The People of the State of California, acting by and through Orange County District Attorney Tony Rackauckas v. General Motors LLC, Superior Court of the State of California in and for the County of Orange Complex Litigation Division, Case No. 30-2014-00731038-CU-BT-CX, Deposition Testimony on April 20 and 21, 2017.
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70. Matthew Townsend, et al. v. Monster Beverage Corporation and Monster Energy Company, United States District Court Central District of California, Case No. 5:12-cv-02188 VAP (KKx), Deposition Testimony on September 20, 2017.
71. Welltower Inc., v. Scott M. Brinker, In the Court of Common Pleas Lucas County, Ohio, Case No. CI-17-2692, Deposition Testimony on October 4th, 2017.

Testimony

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2. State of Tennessee, ex rel., Douglas Sizemore, Petitioner vs. Xantus Healthplan of Tennessee, Inc., Chancery Court of Davidson County, Tennessee at Nashville, Case No 99-917-II, Rebuttal Testimony, October 26, 2001.
3. Howard Wright, Inc., a California corporation doing business as AppleOne Employment Services, Plaintiffs, vs. Olsen Staffing Services, Inc., a Delaware Corporation, Dagny Smith, an individual, Vicky Riechers, an individual, and Linda Shiftman, an individual, Defendants, Superior Court of the State of California for the County of Los Angeles, Case No. BC 200657, Trial Testimony, March 4, 2002.
4. Columbia/HCA Healthcare Corporation - Billing Practices Litigation, United States District Court, Middle District of Tennessee, Nashville Division, Case No. 3-98-MDL-1227 on June 28, 2002.
5. Sacred Heart Medical Center, et al., Plaintiffs v. Department of Social and Health Services, and Dennis Braddock, the Secretary of the Department of Social and Health Services, Defendants, Superior Court of the State of Washington in and for the County of Thurston, No. 00-2-01898-1, Testimony in Liability Trial, April 14, 2003.
6. Diversified Property, a general partnership, Dora Saikhon Family Trust, and Nancy Saikhon Borrelli, an individual, Plaintiffs v. Manufacturers Life Insurance (U.S.A.), a Michigan corporation, erroneously sued as Manufacturers Life Insurance Company, Inc., Defendants in the Superior Court of California, County of San Diego, Case No.: GIC 815128, Trial Testimony on October 25, 2004.



7. Bridgestone/Firestone North American Tire v. Sompo Japan Ins. Co. of America, United States District Court for the Middle District of Tennessee Nashville Division Civil Action NO. 3-02-1117, March 7, 2005
8. Group Anesthesia Services, A Medical Group, Inc., Claimant, vs. American Medical Partners of North Carolina, Inc., etc., et al., Respondents, JAMS Arbitration, Reference No. 1100040919, Arbitration Testimony on March 23, 2005.
9. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Testimony in Liability Trial, on June 28 and 29, 2005.
10. Goldman et al. v. RadioShack Corporation, United States District Court, Eastern District of Pennsylvania, Case No. 03 CV 0032, Rebuttal Testimony in Liability Trial, on July 5, 2005.
11. Mauna Loa Vacation Ownership LLP v. Accelerated Assets, LLP. United States District Court, District of Arizona, Case No. CIV 03-0846 PCT DGC. Trial Testimony, on February 22, 2006.
12. School Districts' Alliance v. State of Washington, United States District Court, Eastern District of Thurston, Case No. 04-2-02000-7, Trial Testimony on November 13, 2006.
13. In the Matter of Premier Medical Group, PC, Appellant – Department of Health and Human Services, Office of Medicare Hearings and Appeals, Southern Field Office, ALJ Appeal No. 1-221579701, Medicare Appeal No. 1-18761858, Provider No. 3706654, AR No. 9406352171039, Judge Zaring Robertson, US Administrative Law Judge, Testimony on April 1, 2008.
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15. R. Molina et al. v. Lexmark International, Inc., Superior Court of the State of California for the County of Los Angeles, Case No. BC339177, Trial Testimony on October 22 and 26, 2009.
16. Dole Fresh Fruit International, Ltd, Hyundai Precision America, Inc., ADRS Case #05-1138-RTA, Trial Testimony on February 19, 2010.
17. In the matter of University of Tennessee Cancer Institute, ALJ Appeal No. 1-446 575 318, Office of Medicare Hearings & Appeals, Judge Z. Robertson, US Administrative Law Judge, Testimony on April 20, 2010.
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19. Marine Engineers' Beneficial Association v. Department of Transportation, Ferries Division Federal Mediation & Conciliation Service Cause No. 110105-52404-6 AGO Matter No. 10499471, July 19, 2011.
20. Richard Robinson v. County of Los Angeles, et. al., United States District Court of California, Central District, Case No. CV06-2409 GAF (VBKx), Trial Testimony on December 1, 2011.
21. In the matter of American Home Patient, ALJ Hearing, Appeal No. 1-982137828, Office of Medicare Hearings & Appeals, Miami Office Southern Field Division, Testimony on October 29, 2012.



22. In the matter of American Home Patient, ALJ Hearing, Appeal No. 1-924297238, Office of Medicare Hearings & Appeals, Irvine Office Western Field Division, Hearing Testimony on February 28, 2013.
23. TaylorMade Golf Company Challenge to Callaway Golf Company's Final Response, National Advertising Division, New York, Testimony on March 13, 2013.
24. United States of America, ex rel. Tammie Taylor v. Life Care Centers of America, Inc., United States District Court Eastern District of Tennessee at Chattanooga, Civ. Action No. 1:12-CV-64, Testimony on May 13, 2014.
25. United States of America v. Houshang Pavehzadeh, United States District Court for the Central District of California, No. CR 13-0320-R, Testimony on May 19, 2014.
26. Sherman Way Oil, Inc. (Bijan Pouldar), American Pacific Enterprises Group (Sherwin Louie), Bahman Kohanteb, Hamid Kalhor, Claimants, Vs. Circle K Stores, Inc., Respondent, Alternative Dispute Resolution Case No's 13-7103-DSC through 13-7106-DSC, Arbitration Testimony on October 10, 2014.
27. Heidi's Children Dental Center (DC14-0813-204-LM) vs. Denti-Cal, Testimony at Administrative Law Judge Hearing, Judge Lewis Munoz, in Los Angeles on November 5, 2014.
28. AdvanceMed Audit of Altercare of Wadsworth, Medicare Appeal, Medicare Appeal No. 1-912446681, Bertha Sanchez, et al. v. St. Mary Medical Center, et al., Superior Court of the State of California for the County of San Bernardino, Case No. CIVDS 1304898, Certification Hearing Testimony on October 21, 2016.
29. Michael Bozsik v. Livingston International Inc., Ontario Superior Court of Justice, Court File No. 5270/14, Cross Examination Testimony on May 12, 2016.
30. Bertha Sanchez, et al. v. St. Mary Medical Center, et al., Superior Court of the State of California for the County of San Bernardino, Case No. CIVDS 1304898, Certification Hearing Testimony on October 21, 2016.
31. In Re Dial complete Marketing and Sales Practice Litigation, United States District Court, District of New Hampshire, Case No. 11-md-2263-SM (MDL Docket No. 2263), Hearing Testimony on November 16, 2016.
32. United Healthcare Insurance Company v. Lincare Inc., Case Improvement Plus of Texas Insurance Company: Care Improvement Plus South Central Insurance Company: Care Improvement Plus of Maryland, Inc. v. Lincare Inc., In An Arbitration Before the American Arbitration Association, Case No. 01-15-0003-4095, Arbitration Testimony on February 6, 2017.
33. The United States of America and The State of Florida ex rel. Angela Ruckh v. CMC II, LLC, United States District Court for the Middle District of Florida Tampa Division, Civil Action No. 8:11 CV 1303 SDM-TBM, Trial Testimony on February 8, 2017.
34. Federal Government of Germany v. A Consortium of Publicly Traded Companies in an arbitration under the laws of Germany, Arbitration Testimony on March 21 and 22, 2017.



35. In Re Determination of Royalty Rates and Terms for Transmission of Sound Recordings by Satellite Radio and "Preexisting" Subscription Services (SDARS III), United States Copyright Royalty Judges The Library of Congress Washington, D.C., Docket No. 16-CRB-0001-SR/PSSR (2018-2022), Trial Testimony on May 9, 2017.
36. ZPIC Audit Appeal of Providence Health System Southern California, Office of Medicare Hearings and Appeals, OMHA Appeal Number 1-1823418684, Hearing Testimony on October 16, 2017.

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Professional and Business History

- » Berkeley Research Group, 2010 - Present, Managing Director
- » Resolution Economics, 2008 - 2010, Partner
- » Alvarez & Marsal, 2007 - 2008, Managing Director
- » LECG LLC, 2005 - 2007, Director
- » Navigant Consulting Inc., 2004 -2005, Managing Director in Litigation and Investigation Practice
- » Deloitte & Touche LLP, 2003 - 2004, Leader of the Economic and Statistical Consulting Practice in the West Region
- » PricewaterhouseCoopers LLP, 2002 - 2003, Leader of the Litigation Consulting Group in Los Angeles, Leader of the Economic and Statistical Consulting Practice in the West Region
- » Andersen LLP, 1992 - 2002, Partner (since 2000), last position held: Director of Economic and Statistical Consulting practice in the Pacific Region
- » University of California, San Diego, 1989 - 1991, Teaching Assistant, Department of Economics
- » German Government, 1986 - 1989, Economic Research Assistant